

POPULAR SCIENCE

MONTHLY

April 15¢

Mechanics & Handicraft

SEE
PAGE
109



THIS ISSUE: More Mileage with Super-Gas

"THE HEAVY LINE DRAGGED ME TOWARD ETERNITY!"

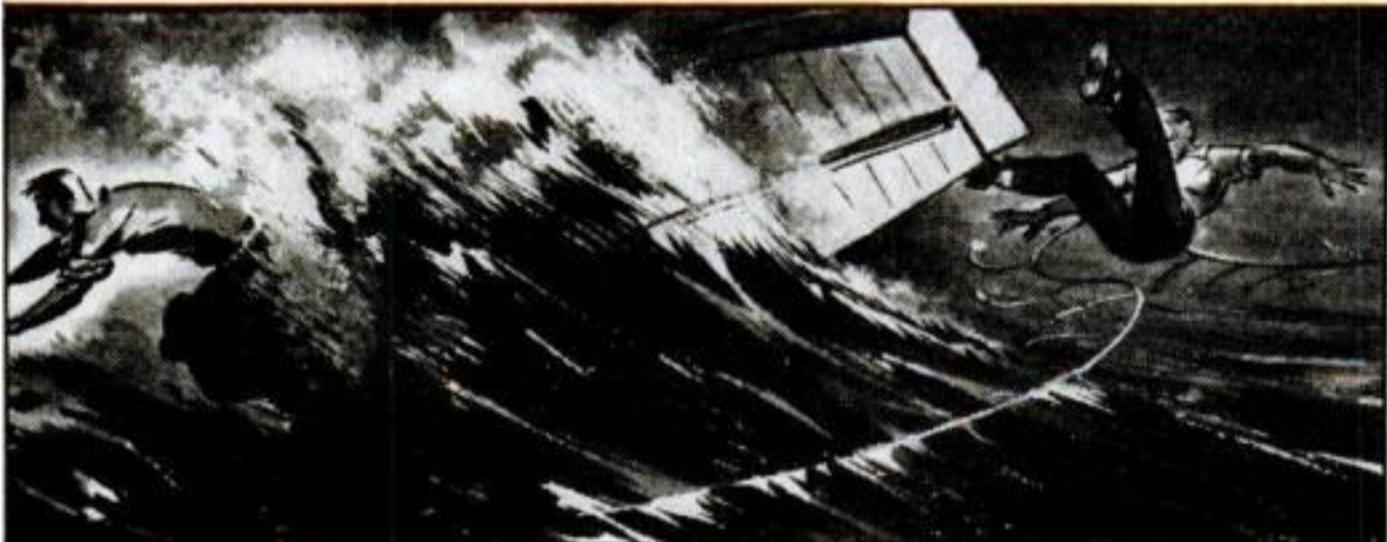


A true experience of C. J. LATIMER, Warren, Ohio



"**ANOTHER FISHERMAN** and myself had just finished setting a heavy trot-line in Lake Erie," writes Mr. Latimer, "when a sudden treacherous squall lashed out of nowhere and churned the water into towering waves.

"A WAVE SMACKED us broadside, and over we went! Then I felt a heavy drag on my leg. I was caught in the trot-line and was being pulled to my doom. In the darkness, my companion couldn't untangle me!

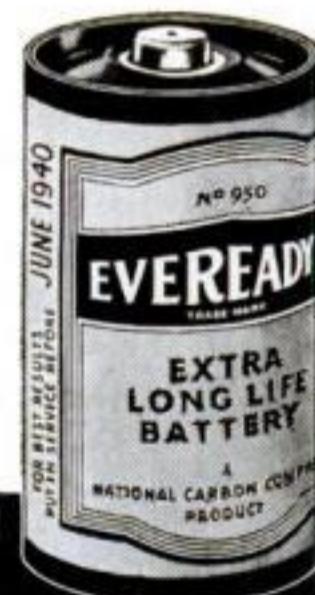


"BUT ONE OF OUR PARTY ON shore brought his flashlight into action. Its powerful beam cut the distance and darkness—and in a minute I was free. I shudder to think of what might have happened except for those dependable 'Eveready' fresh DATED batteries!

(Signed)

C. J. Latimer

The word "Eveready" is a registered trade-mark of National Carbon Co., Inc.



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NATIONAL CARBON COMPANY, INC., 30 EAST 42nd STREET, NEW YORK, N. Y.
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Here's the New Measure of "All Three" Quality!

- 1 Compare "All Three" low-priced cars on the 1940 Quality Chart to see how much more size, safety, comfort, and quality Plymouth gives you.
- 2 Complete this evidence to your own satisfaction by taking Plymouth's great Luxury Ride.



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TO THE
BIGGEST VALUE

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QUALITY CHART
FOR FACTS**

**2-TAKE THE
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FOR PROOF**

Of 22 Features Found in High-Priced Cars—

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SEE HOW MUCH more quality and value this 1940 Plymouth gives you! It's the only one of "All 3" low-priced cars that gives you a majority of the 22 important features found in high-priced cars.

See the Quality Chart...then take the Luxury Ride. Plymouth Division of Chrysler Corporation.



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Delivered in Detroit, Mich. Prices include Federal taxes. Transportation and state, local taxes, if any, not included.

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POPULAR SCIENCE

MONTHLY
Mechanics & Handicraft

Founded 1872

Volume 136, No. 4

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ALDEN P. ARMAGNAC, Associate Editor

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SYDNEY OXBERRY, Art Editor

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GREAT NEWS! Here comes Mickey Rooney as young Tom Edison, the boy who grew up to be the world's greatest inventor! Watch him doing experiments at his cellar workbench—and playing tricks on his schoolmates. See him save a train from being wrecked! It's thrilling—a picture that you and your whole family will want to see!



The Bridge is Out! Wires down! Tom races to the river with the steam-whistle screaming a message of warning in Morse code! Will they hear the signal in time?

MICKEY ROONEY as YOUNG TOM EDISON

with FAY BAINTER • GEORGE BANCROFT

VIRGINIA WEIDLER • EUGENE PALLETTE • Original Screen Play by Bradbury Foote, Dore Schary and Hugo Butler • Directed by Norman Taurog
Produced by John W. Considine, Jr. • A METRO-GOLDWYN-MAYER PICTURE



Rescue! A runaway freight train thunders down the track! Tom heroically risks his life to save the baby son of the station telegraph operator!



Light! With a "borrowed" mirror and every kerosene lamp in the house, Tom makes the room as bright as day! Now the doctor can operate on Mrs. Edison!



Soon another great picture about Thomas Edison will come to you from Metro-Goldwyn-Mayer. This one, starring Spencer Tracy, is called "EDISON THE MAN", and it continues the fascinating story of one of the most exciting lives any American ever lived. Watch for it!

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WITH ADDITIONAL TRAINING CAME BETTER POSITIONS



"With a high school education I sought here and there looking for a job. Finally I found one as clerk in an office. There wasn't much ahead of a mere clerkship unless I made a study of something that would get me further along the line. It was then that I decided to enroll with the International Correspondence Schools.

"The course was interesting from the very beginning and the service was everything I could desire. The time came when I graduated and secured the diploma of which I am very proud. And with the additional training came better positions until I have become Assistant Treasurer of the Company with which I am connected.

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• Thus, in his own words, the Assistant Treasurer of a nationally famous manufacturer of asbestos products tells of his achievement.

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- Coal Mining
- Concrete Engineering
- Contracting and Building

- Accounting Advertising
- Bookkeeping
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- Business Management
- Cartooning

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- Diesel Engines
- Electrical Engineering
- Electric Lighting
- Fire Bosses
- Fruit Growing Heating
- Heat Treatment of Metals
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- Locomotive Engineer
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- Management of Inventions
- Managing Men at Work
- Manufacture of Pulp Paper

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- Cost Accounting
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- Welding, Electric and Gas
- Woolen Manufacturing

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City..... State..... Present Position.....

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AND FIVE
GILLETTE BLUE
BLADES

49¢



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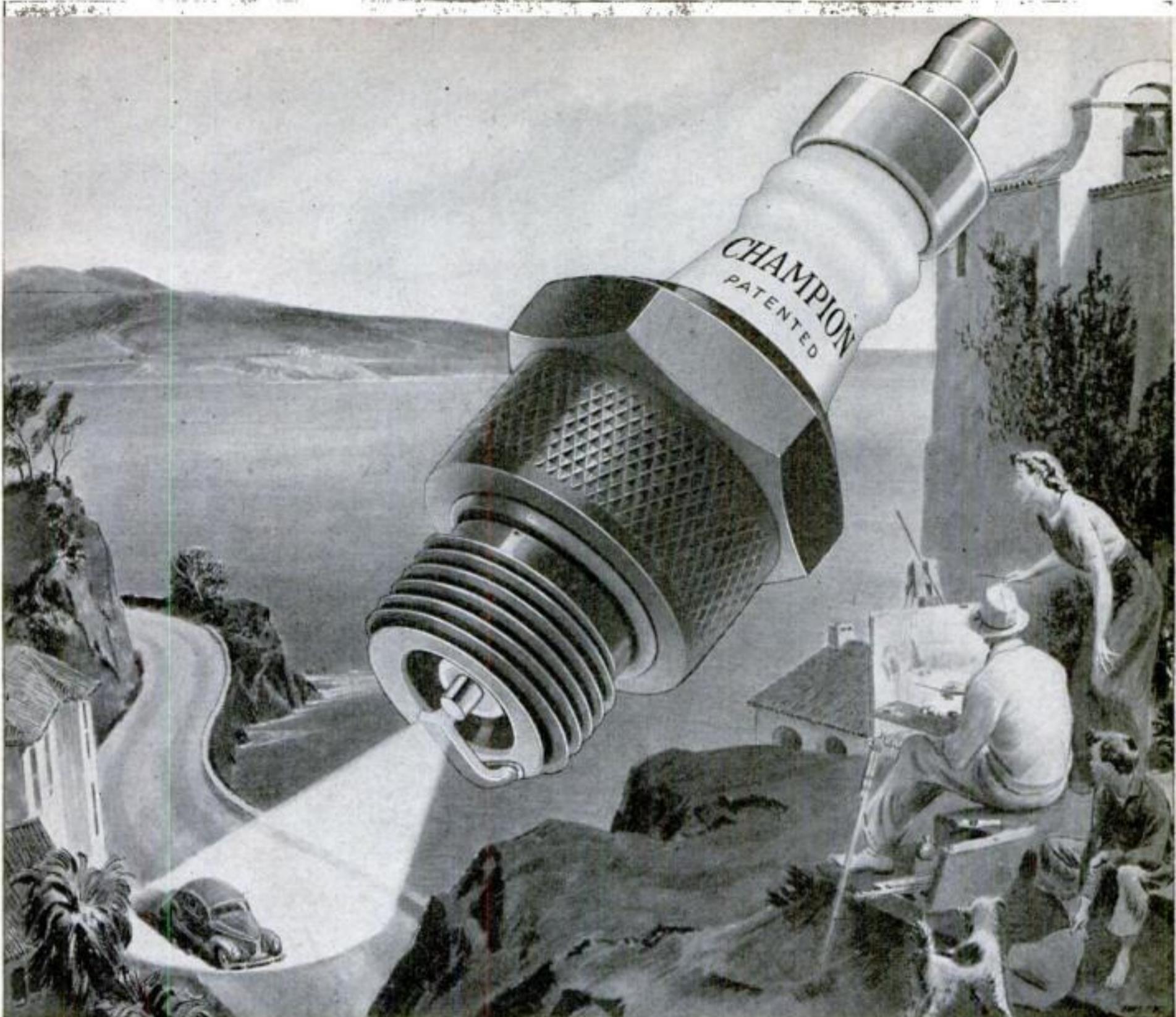
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ENJOY MOTORING TO FAR PLACES WITH NEW CHAMPION SPARK PLUGS!

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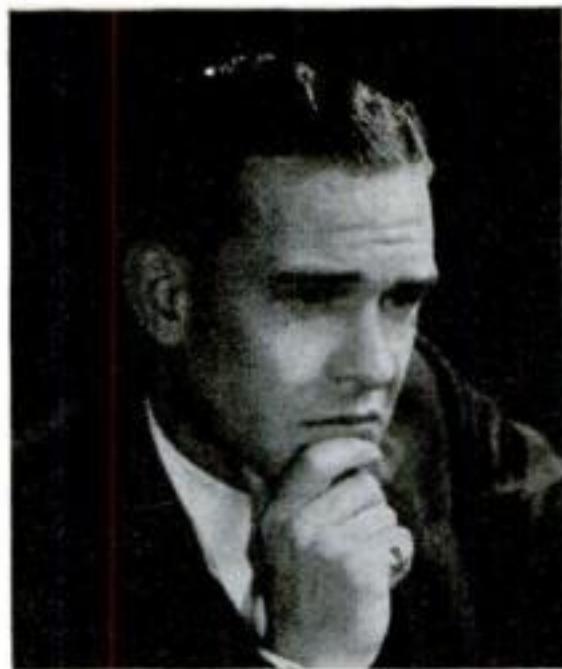
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HOW SAFE IS



YOUR JOB?

CAN YOU CLASS YOURSELF AMONG THE "OK-MUST KEEP!" EMPLOYEES?

NO USE dodging facts!

At times—in every company's history—the pay-roll goes onto the operating table for major surgery.

And when such times come, certain employees are amputated—sometimes a few, sometimes many.

Yet a certain few are always marked "OK-Must Keep!" And the many who are let out envy them—call them "lucky."

What's Behind Job-Holding "Luck"?

It can be *proved*, however, that there's almost always something more than luck involved.

Even the fellow who seems to "have a drag" may actually have a lot more on the ball than is apparent to his fellow workers.

He may have hidden values that only his superiors see or know about.

After all, the "I-Gotta-Drag-Club" has taken a bad licking. In fact, it rather completely disbanded in 1932-1933.

Yet why is it that some employees hold their jobs at the very time when others of seemingly *equal* ability lose theirs?

If it's not luck, there *must* be some explanation. And there is one!

How to Insure Your Job

The secret of holding your job in hard times is to be invaluable to your employer. And a man or woman who is invaluable is usually a well-trained one.

Training is of many kinds—stems from many sources. But the LaSalle kind has been unusually successful. Nearly a million members, in a score of subjects, over a thirty year period can testify to that—and many can prove it by their pay envelopes!

They have cause to agree with us that the real secret of both promotion and job security is just this: "On your present job, make sure you are doing it well, then *train* for the job ahead!"

Why It Works

Put yourself at your own president's desk for a moment.

You are faced with cutting the pay-roll. First of all, you certainly are going to do your best to hold on to those employees who really know their present jobs.

But among them—the very last to go will be those

LASALLE EXTENSION UNIVERSITY A CORRESPONDENCE INSTITUTION Dept. 483-R, CHICAGO

I'd like to know what you can do to help me better my job. Send me your free booklet and full details about the training I have checked below:

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Age _____

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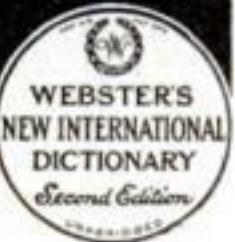
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When You Say "Webster's Dictionary"
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Accept Nothing Less Than
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LOOK FOR THIS CIRCULAR TRADE-MARK
AND THE "NW" MONOGRAM ON THE COVER.



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At the death of Noah Webster in 1843, the G. & C. Merriam Company bought and paid for the exclusive rights to publish the only genuine Webster's Dictionary.

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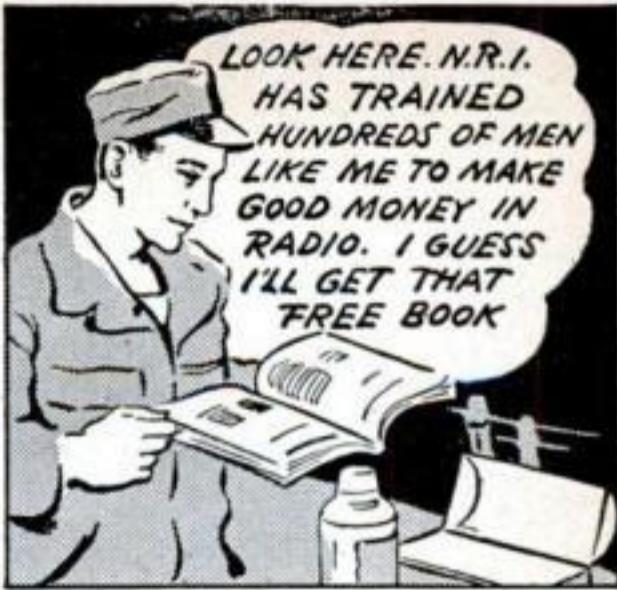
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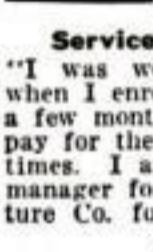
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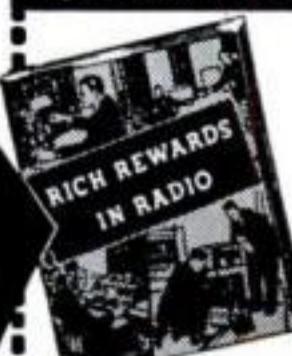
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Our Readers Say

The Home Workshop Department Got Him Off to a New Start

YOUR Home Workshop Department has been a course of instruction to me that means as much as my schooling. Thirteen years ago I was taken ill with arthritis that left me handicapped with a crutch under each arm. I was a machinist and draftsman, but when I got well enough to work again I found there just wasn't any to be had. I had to make a job for myself, so I turned to the POPULAR SCIENCE Home Workshop Department for patterns and made toys, novelties, and small pieces of furniture. Although I sold all I could make, I had a feeling that the things I sold were bought out of sympathy, until about 1935 when I won first prize in one of your novelty-making contests. It gave me the self-assurance I needed. By 1936, my articles were being sold all over Baltimore. Finally, I was offered a job by the Goodwill Industries as the head of their toy department. I have been there three years now, and my toy department has grown from a back room to two floors. I owe much to Mr. Arthur Wakeling's ability as editor of the Home Workshop Department, for nearly all the assistance and patterns I used came out of his department.—C. G. S., Baltimore, Md.

She Could Probably Tell HIM a Few Things About Styles



ONE thing that always astonishes me is the way modern women make use of all the wonderful inventions in the home without (apparently) feeling the slightest curiosity about what makes them work. Take my wife, for example. She knows that by plugging a cord into an electric

outlet she can get heat in a toaster, cold in a refrigerator, light in a lamp, work in a vacuum cleaner, or Bing Crosby on the radio. But does she know how the same electric current can be made to perform all these different tasks? She does not! And what is even more astounding, she doesn't seem to give a darn. The other night, I spent half an hour telling her what makes an electric iron heat. But don't ask her about it; she wasn't listening. Her mind (?) was on some clothes ad she had seen in the paper.—O. D., Minneapolis, Minn.

(Continued on page 14)



He Favors New-Car Gimcracks That Really Are Useful

DURING this last winter's cold spell, I went out hopefully to the garage on more than one freezing morning only to find that my battery was too weak to start the motor. With all the new gimcracks they've got on cars now, it seems to me it wouldn't be very difficult to provide some sort of connection on the dashboard that could be plugged into the nearest light socket to provide six volts of direct current to turn the starter motor. As far as I'm concerned it would be a lot more useful than steering-gear shift levers, automatic tops, and overstuffed fenders.—J. H., Utica, N. Y.

WHAT GOOD WOULD IT BE AWAY FROM THE GARAGE?



Take It from One Who Knows: The Thermostat Is Hot Stuff!

IT SOUNDS to me as though W. D., of Baltimore, Md.,—the singer of unsung heroes—might be referring to the thermostat and the various applications of it. Take it from one who appreciates the many services this little device performs, it is one of the most important contributions of science to modern living!—Miss I. B., Kansas City, Mo.

Proposes That Scientists Strike Against War

APPARENTLY all the inventors are turning their talents now to creating engines of destruction. I see that the British Ministry of Supply has had to set up a large organization just to examine the hundreds of inventions that are offered every week. Death rays and similar cheerful little gadgets are being turned out by the score. And now the British and French have established a "pool of brains"

OH, YEAH? THE STONE-AGE BOYS DID PRETTY WELL!



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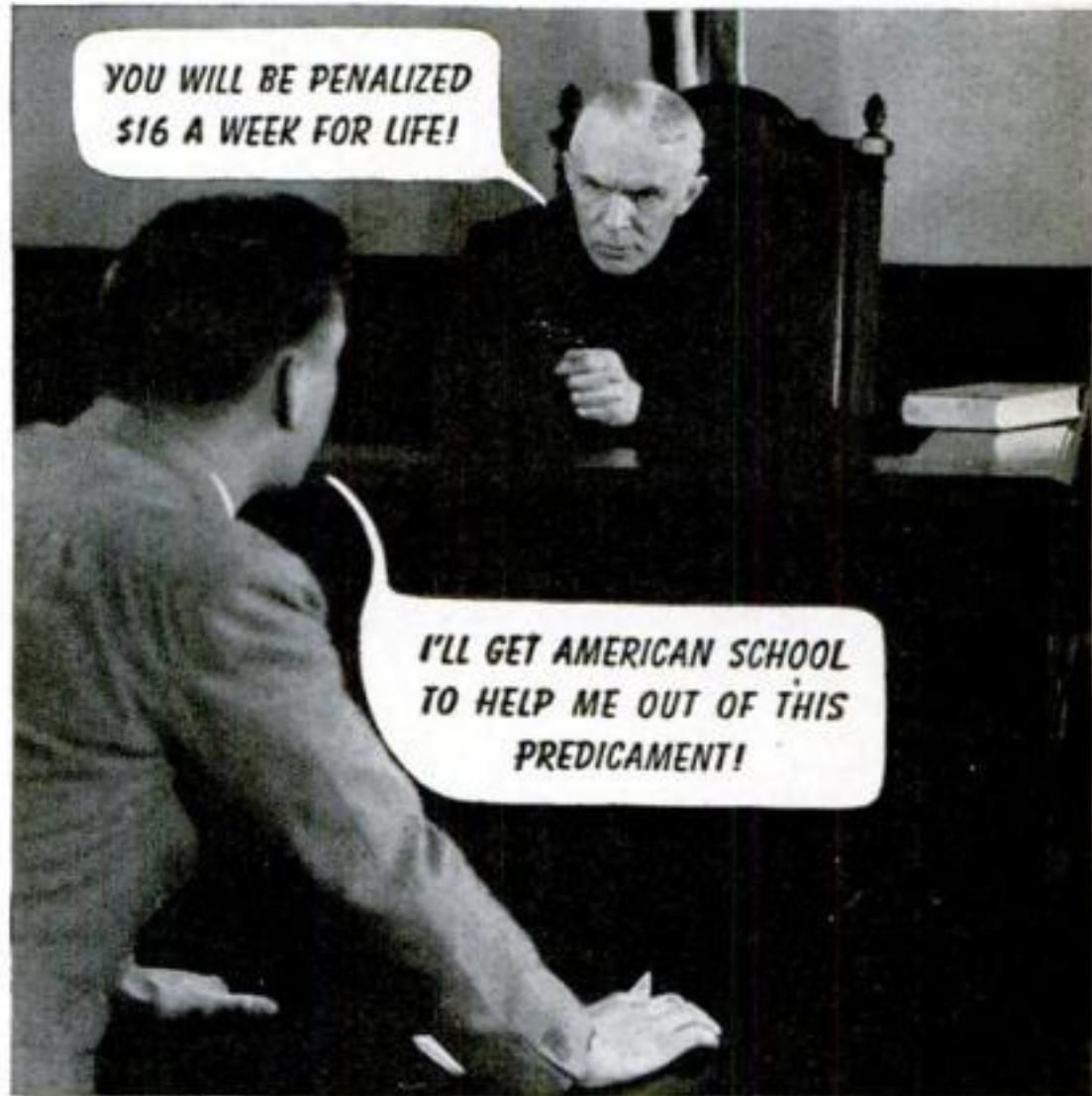
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Our Readers Say

(CONTINUED)

in which the best minds of both nations will coöperate to devise new weapons and counteract those of the enemy. What the scientists ought to do is to go on strike against the whole silly business, and let the boys fight their wars with sticks and stones. It ought to be just as much fun that way, and there would be a lot less damage.—A. D., Boston, Mass.

Pall of Ship's Smoke Appalls This Reader

IT APPALS me to see how much valuable space is taken up by the smoke stacks on ships. Instead of letting the smoke rise by its own lazy, leisurely buoyancy in one or

HOW'S THE LINE GOING TO SHOW ITS COLORS?



more huge stacks, I suggest that only one or two small exhaust pipes be used, and that the smoke be forced out by a steam or electric fan of a strength equal to the lifting effect of a smoke-stack draft. The speed or power of the fan would be automatically regulated to supply the demands

of the boilers. Also, instead of the smoke issuing from one point and getting into passengers' eyes or all over the ship's paint when the wind blows the wrong way, it would be possible to expel it from either end of the vessel.—A. V., New York City.

Try This One On Your Phonograph

HERE is a little experiment with a phonograph that I hope some reader can clear up for me: Out of curiosity, I once put a small marble on top of a phonograph record, which was rotating at about standard speed. Two fingers prevented the marble from moving along with the record, and held it spinning in the opposite direction. To my surprise, I found it possible to withdraw my fingers and leave the marble still spinning, at just enough speed to offset the rotation of the turntable. With its center perfectly stationary in space, it made an odd sight, like a man walking up a "down" escalator. Finally, after perhaps a quarter of a minute, the marble would be seized by



(Continued on page 16)

the turning record and whirled off. But in the meantime, how did the marble stay put, with apparently nothing to hold it?—A. G. K., Pasadena, Calif.

Well, Why Doesn't He Try a Secondhand Store?

READING in your last issue about the girls who earn their salt by breaking in new shoes for customers of a New York shoe store makes me wonder why some enterprising business man hasn't started a "suit-breaking-in" service for men. Frankly, I don't think there's anything more uncomfortable than a new suit, unless it's a pair of clean golf pants. Now that broken-in shoes have joined broken-in pipes, how about broken-in suits?—P. T. G., Oklahoma City, Okla.

S'TOUGH, TRY AN OLD ONE IN FREEZING WEATHER!



If He's Already Gone That Far the Rest Ought To Be Easy

AS I was looking through your magazine recently, I noticed an interesting article on model airplanes. The pickaback plane is the one I'm talking about. It was a gas-powered job that carries a smaller plane aloft on its back. After a while, the small plane is released, and descends slowly by parachute. I wrote a letter to a friend in Pennsylvania, and he told me all the details about the construction. I am now working on it and am almost finished. My one problem is how to make the chute open after the little plane leaves the big plane. If any of your readers know anything about it, could they let me know, too?—D. T., Washington, D. C.

A Shock Absorber for the Nerves Is What Parachute Jumpers Need

WHEN I came to that recent item about the life-line shock absorber for steel workers, I remembered a parachute jump I once watched through field glasses. It looked to me as though the jumper would be jerked apart by the sudden stop when the chute opened. Why can't the idea of the Denver man, who has worked out a safety harness with a rope and brake that slows down a workman gradually if he falls from a high building, be applied to putting "knee action" in parachutes? Let the jumper continue a little farther in such a brake-and-rope harness when the 'chute opens. That would iron out the terrific jerk at the bottom

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Our Readers Say

(CONTINUED)

of the drop and eliminate the danger of physical injury.—R. M., Miami, Fla.

A Play in Five Acts with Plenty of Mystery

THIS one will leave you with your tongue hanging out—but not for anything flavored with coconut. Five men shipwrecked on a tropical island gather a large pile of coconuts, then retire for the night. After a while, one man decides he'll make sure of getting his share, so he sneaks to the pile, and divides it into five equal parts after throwing one away to make the parts come out even. He then takes his fifth, hides it, and leaves the remaining four fifths. Presently another steals out and does the same thing to what's left of the pile after he too throws one away to get an even division of fifths, hiding his own fifth and leaving the rest. The third, fourth, and fifth of the party in turn go through the same act, each discarding one and taking a fifth of the remainder. Got it? Now, the question is, what is the smallest number of coconuts for which this little drama in five acts would be possible?—A. D. W., Rensselaer, Ind.

AND NOBODY NOTICED
HOW THE PILE HAD
DWINDLED?



Thanks, We'll Take Ours With a Grain of Salt

THAT item in your March issue, about the "artificial earth" for model-railway roadbeds, handed me a laugh. You say that this material is harmless if swallowed accidentally by children. Well, I have been using an artificial earth for the same purpose, which not only is harmless if swallowed, but is actually good to eat! I discovered by accident that a certain breakfast cereal, which is made in the form of hard granules, makes a realistic ballast for model tracks. Put that in your bowl and eat it!—M. J., Toronto, Canada.



fast cereal, which is made in the form of hard granules, makes a realistic ballast for model tracks. Put that in your bowl and eat it!—M. J., Toronto, Canada.

If She Reads This He'll Get a Darn Good Sock!

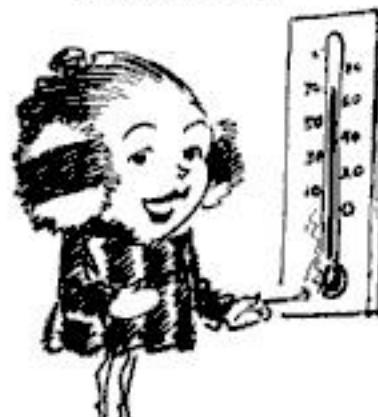
So THE ladies have an automatic sock patcher now. According to the item on page

133 of your March issue, all they have to do is put a sock (with hole) on the device, superimpose a blow-out patch, attach a top piece, and turn on the electricity. Presto, the sock is patched! No doubt it works perfectly. There's just one thing about it, however, that the inventor overlooked entirely, and his claim to everlasting fame and immortality will be strictly limited until he corrects the oversight, namely, something to make the wife use the thing at all. I'd rush to be the first to buy one, even though it did a poorer job than the old-fashioned needle and thread, if I could be sure my wife would do anything but put it in her sewing box with the rest of the unused darning paraphernalia. Which reminds me, her sewing box itself is a trick timesaver. It has a lot of labeled buttons with doors that pop open when they're pressed to make everything easy, and—oh well!—F. T., Newark, N. J.

A Simple Way To Test Thermometer Accuracy

WONDER how many of your readers really understand why a thermometer in the sunshine registers a temperature which is often considerably higher than the air around it.

A KILL-OR-CURE
PROCESS!



steam from boiling water (at sea level) and see how far from 212° it settles (if it reads that high). That will help you guess how far off readings in between may be.—Mrs. M. E. C., Watertown, N. Y.

JANUARY LETTER CONTEST PRIZE WINNERS

THE following are the prize winners of the Letter Contest announced in our January 1940 issue:

First Prize, \$50: E. I. Waite, Inglewood, Calif.

Second Prize, \$25: Dale Kennedy, Clare, Mich.

Third Prize, \$15: M. Henley, Atlanta, Ga.

Fourth Prize, \$10: E. W. Bowie, Northampton, Mass.

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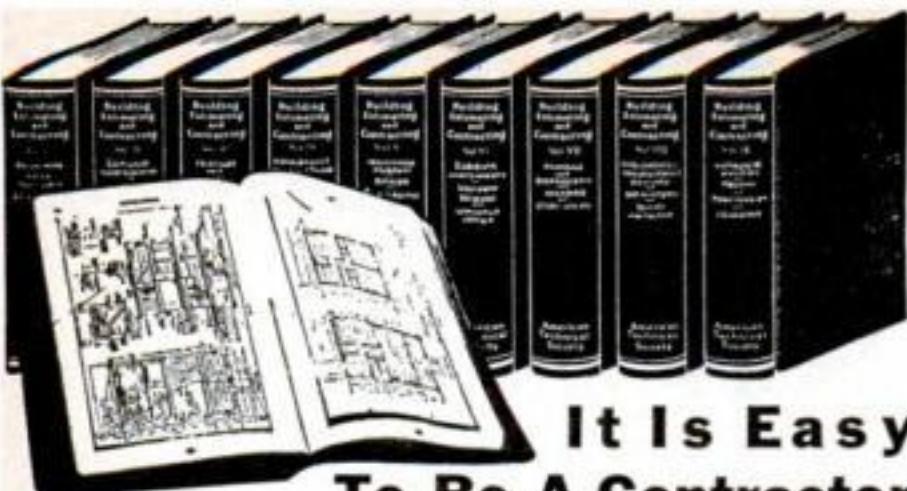
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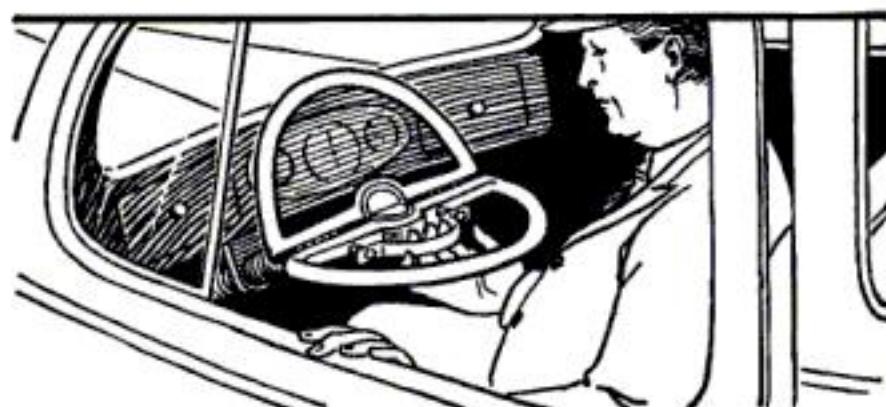
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With the Inventors

CHANGE is automatically made when a dime or quarter is inserted in a robot cashier worked out jointly by William B. Evans and Duward A. Lawson, of Nashville, Tenn.

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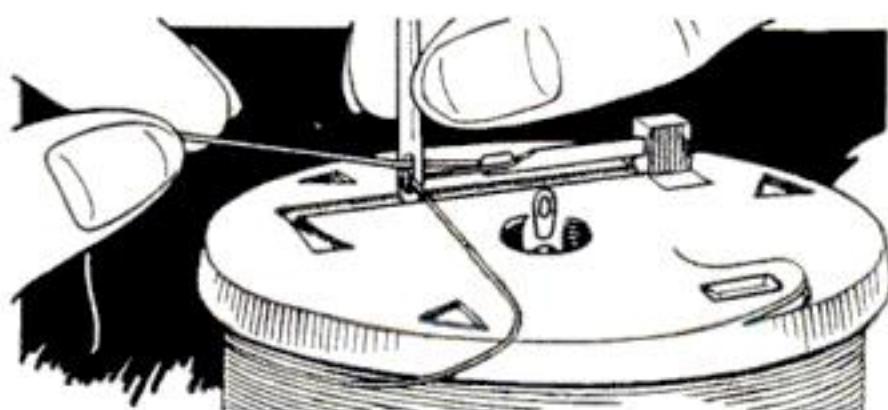
How MANY BREATHS would it take for you to sputter out the name of the chemical compound covered in patent 2,186,773 : "2(p-nicotinylaminobenzenesulfonamide)-pyridine"? . . . EVEN THE FAT LADY AT THE CIRCUS should have little trouble easing herself into or out of the driver's seat of an automobile equipped with a folding steering wheel, a development credited to Prentis E. Erickson, of Minneapolis, Minn. The wheel is constructed with a single transverse spoke that is split and hinged together so that the bottom



section of the wheel can be folded upward and out of the way, leaving plenty of room for the driver to slide in or out. The folding wheel should also prove convenient when a front-seat passenger desires to get in or out through the left-hand front car

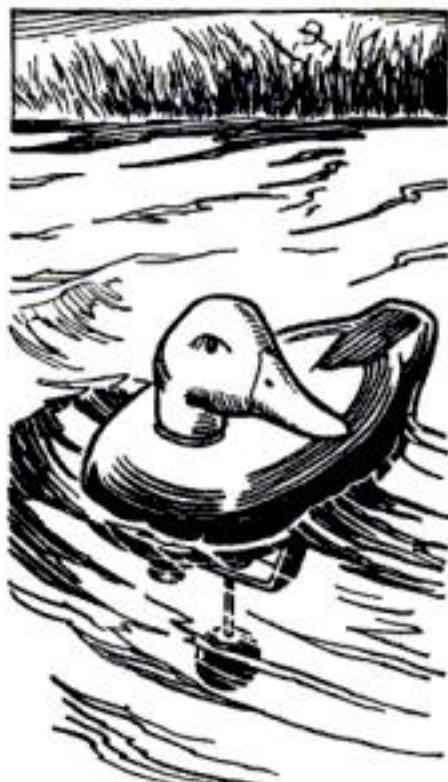
(Continued on page 22)

door . . . THE LAW DOES NOT PROHIBIT anyone from infringing on a patent. However, the owner does have the right to sue those who do infringe . . . DESIGNED TO BE ATTACHED to the end of a spool of thread, an ingenious device worked out by Ralph Brown, of Vancouver, B. C., Canada, provides a means for holding the end of the



thread against accidental unwinding, a way to cut the thread easily, space for holding a needle not in use, and an arrangement for threading the needle quickly and conveniently. All parts of the four-purpose assembly, whose needle-threading operation is pictured in the illustration, are mounted on a metal plate that fits over one end of the thread spool . . . IF BY MISTAKE A PATENT is issued that never should have been granted—because of a prior patent covering the same invention, for example—that patent is invalid. For this reason, it is vital to inventors that a thorough search of the Patent Office files be made before a patent is applied for . . .

EVEN HUNTERS THEMSELVES MAY BE FOOLED by the action of a novel duck decoy invented by Domenic Bonetti, of Portland, Me. In the water, the new decoy is said to turn its head right and left in a remarkably lifelike manner. This action is accomplished by means of a weighted arm that hangs down into the water below the center of gravity of the wooden bird. Wave motion of the water on which the decoy floats moves the weighted arm, which in turn transmits a turning motion to the duck's swivel head



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This may—often does—give rise to complications. Thomas Edison is considered the father of motion pictures. But it is a known fact that a man by the name of Leroy was also an early inventor in this field. Edison was more diligent in taking steps to protect his

rights. The Patent Laws favor the man who is diligent.

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Your very first step is to fully inform yourself—KNOW WHAT TO DO. Find out how the Patent Laws can protect you, what steps are necessary to apply for a Patent, what kind of a sketch, drawing or "disclosure" is needed—what other diligent inventors have done to protect themselves. These facts and many more are simply and clearly explained in the FREE books shown on this page. They are yours for the asking. With them you can quickly place yourself on the SAFE SIDE so far as your knowledge of Patent procedure is concerned. The coupon below was put there for YOU! Use it NOW!

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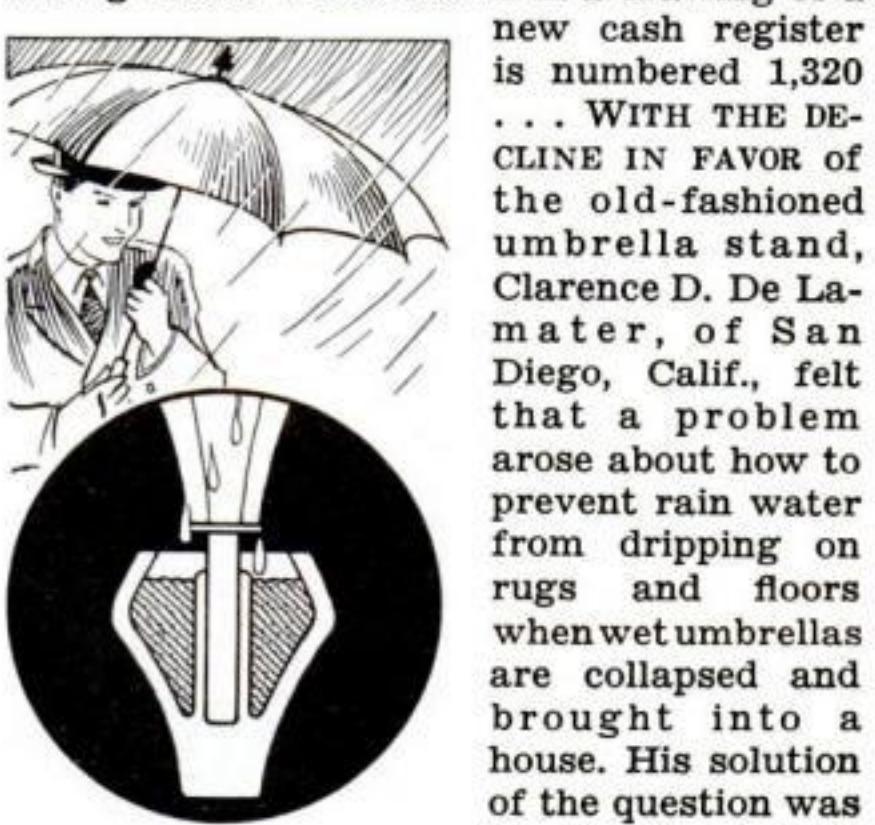
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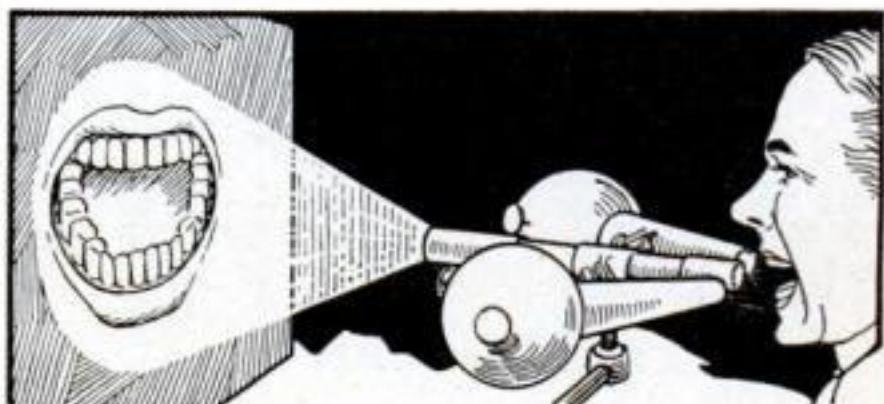
With the Inventors

(Continued from page 20)

. . . IN PATENT DRAWINGS, each part of a device is numbered. An idea of the intricacy of some patented machines can be gained by noting that a wheel shown in a drawing of a new cash register is numbered 1,320



. . . WITH THE DECLINE IN FAVOR of the old-fashioned umbrella stand, Clarence D. De Lamater, of San Diego, Calif., felt that a problem arose about how to prevent rain water from dripping on rugs and floors when wet umbrellas are collapsed and brought into a house. His solution of the question was to invent a drip catcher that fastens onto the tip of an umbrella's central supporting rod. Hollow, and made of a resilient waterproof material, the attachment is large enough to catch and store the rain water that drips down off the umbrella fabric. When the umbrella is opened for use again, the collected water spills out, thereby emptying the drip catcher . . . SINCE THE LAW ENABLING new varieties of plants to be patented was passed in 1930, less than 400 plant patents have been issued . . . MAGNIFIED IMAGES IN NATURAL COLOR of the interior of a patient's mouth can be projected on a screen with a novel apparatus designed especially for dental uses by Jacob A. Safir, of Rockford, Ill. Arranged in front of reflectors in special housings, powerful elec-



tric lamps flood the interior of a patient's mouth with strong light. The image of the mouth interior is then projected on a screen by means of a system of optical lenses. With this projecting apparatus, tooth cavities are much easier to locate, the inventor declares.

(Continued on page 24)

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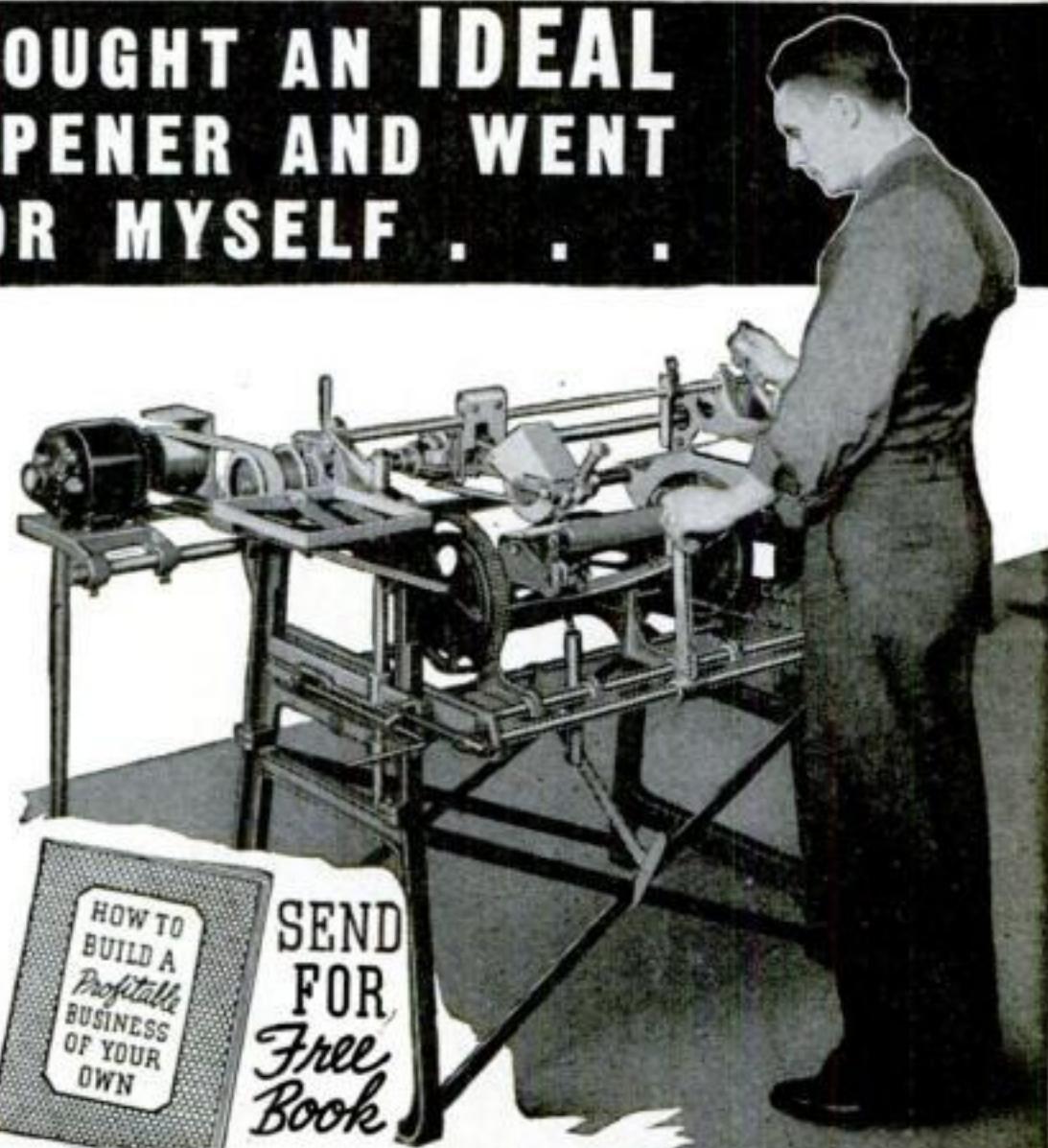
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With the Inventors

(Continued from page 22)

In addition, the device makes it easy for a dentist to point out tooth defects or repairs to the patient himself, and aids the dentist in checking up on his own work . . . A RARE BOOK, OR ONE HAVING exceptional value for other reasons, can be protected from



soiling or damage caused by the thumbs of a reader as he holds it in an open position, by means of protectors recently invented. Oval sections of a transparent material are provided with flanges designed to fit over the thumb. When being worn, the thumb guards protect the book pages by sliding easily over the surface of the paper. The print can still be read even though the guards extend partly over the printed matter. This idea was thought up by Elias E. Lemire, of Cloquet, Minn. . . . WHEN WRITING TO THE PATENT OFFICE, it is well to bear in mind rule eight, which states that "a separate letter should in every case be written

in relation to each distinct subject of inquiry or application." . . . ALBERT GRAMPP, NEW YORK CITY INVENTOR, has provided an answer to anyone who says that riders on a seesaw never get anywhere except up and down. For he has devised for youngsters a traveling seesaw in which the up-and-down movements of the riders are translated by means of cams, levers, and

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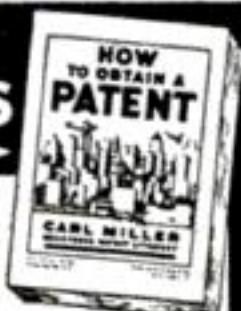
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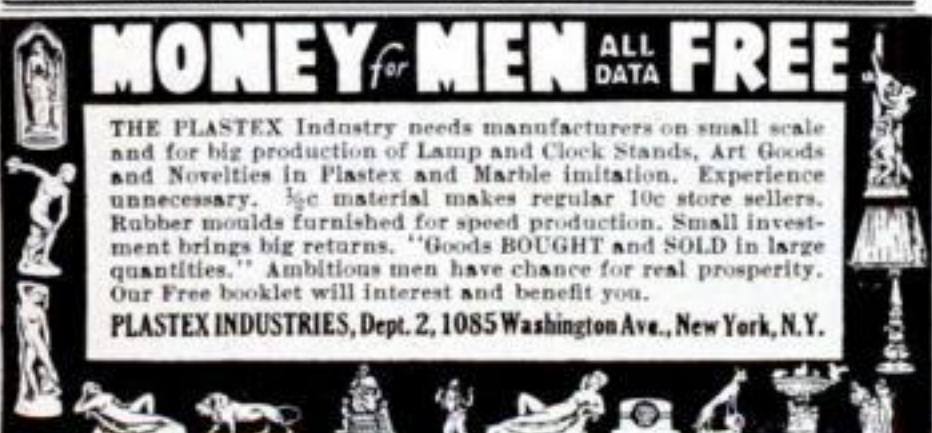
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New Cleaning Compound Removes Rust, Stains

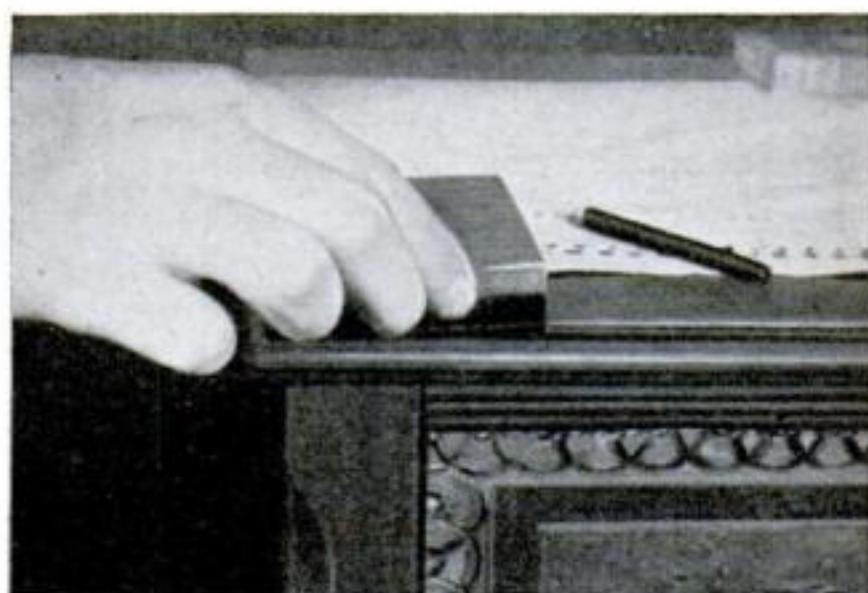
HOME OWNERS should find many uses for a new cleaning compound that is said to remove rust and heavy stains from all enamel, porcelain, tile, or metal surfaces. Specially designed for cleaning use in the bathroom, laundry, and kitchen, the compound may also be employed in restoring the original natural luster of surfaces made of such stone as marble and granite, and of chromium, steel, copper, German silver, and other metals frequently used in the home. Sold in fourteen-ounce containers, the product is reported to be specially useful for keeping kitchen ranges and refrigerators neat.



Using the four-pound electric sander. At left, a close-up view

Polishing Block Erases Furniture Scratches

MINOR scratches, marred spots, and scuffed places on furniture are removed quickly merely by rubbing them with a special block, according to the manufacturers who have just placed it on sale. The block is made of felt impregnated with a chemical solution and fitted with a wooden top which makes it easy to grasp in the hand. It works equally well on walnut, oak, or mahogany.



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This new portable electroplating outfit plates on the spot, where article is located. No dismantling.

or shop, or store, or office, and in many other places, too, for replating thousands of old, worn articles and making them brand-new again. And therein lies a newly found way for a man to fatten his pocketbook in a life-time business of his own in a fully, legally protected territory.

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Easy to operate, this machine can be used by anyone anywhere to deposit a heavy plating of gold, silver, nickel, copper, brass, zinc, cadmium, tin, etc., on metal articles, as simply as painting a board with a brush.

How Seven Men Cashed In

And has somebody hunting for a big, steady income, actually used the process to his profit? Listen to this:

"I got a typewriter rebuilding company to let me go over 100 machines. And then a jewelry loan company gave me an order for replating their musical instruments. I have even gone into a home to plate some faucets and made \$10.00 in three hours," says W. R. Dixon, of Missouri.

"Three pairs of automobile reflectors netted me five dollars, the plating costing seventy-five cents," remarks E. Edwards, of Pennsylvania.

"I have made \$2.50 in an hour's time," O. G. Brewer, of St. Marys.—"I charge \$1.50 an hour for my time," says Roy Kurtz of Greensburg.

"I chose to plate surgical instruments and found it to be very profitable. In the past 3 months I have made over \$150.00 in my spare time," says Lewis Goldstein of New York.

"I quit a job I was on for 11 years. I plate most anything and everything. I average 5 times as much working for myself as I did working for somebody else, and I am my own boss now," reports R. C. Bogart of Florida.

"As a sideline I average \$20.00 a week. I put an ad in a paper. Then I arranged to pay a music store owner ten cents on every dollar of work he turned over to me. I had cards printed. I display my work and boy, does the work come in!" So reports Ray Kuhns, Maryland.

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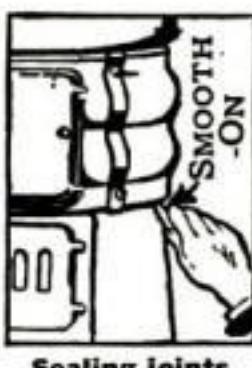


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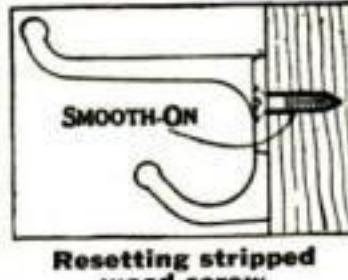
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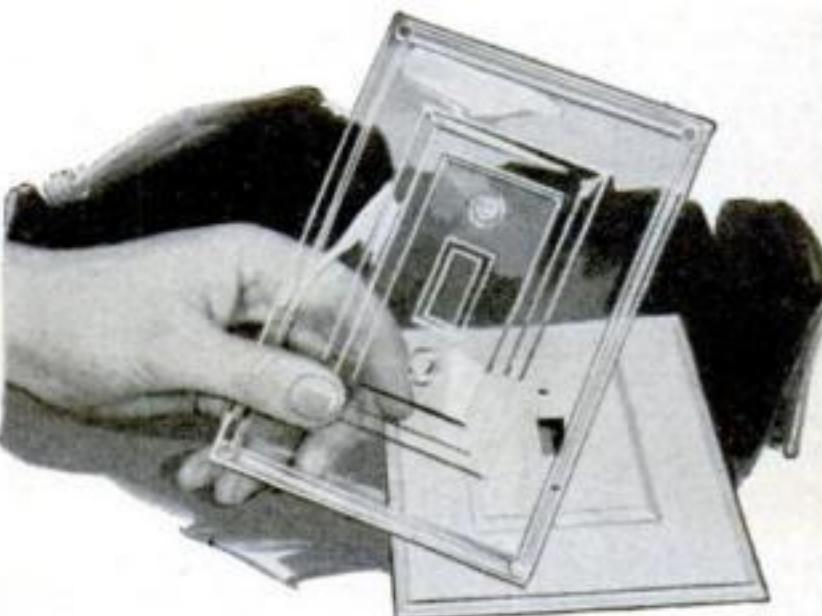
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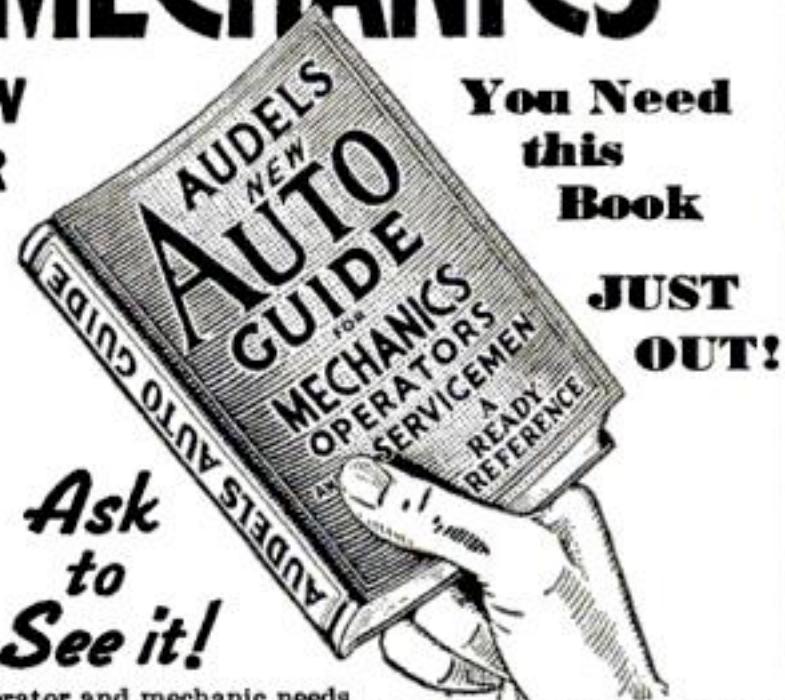
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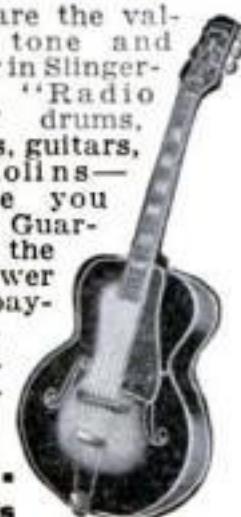


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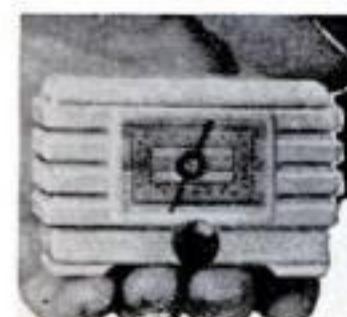
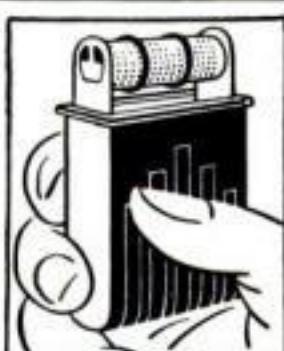
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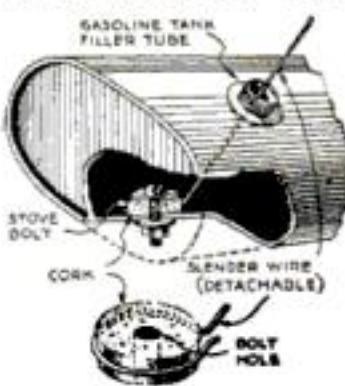
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RADIO engineering, broadcasting, aviation and police radio, servicing, marine and Morse telegraphy taught thoroughly. All expenses low. Catalog free. Dodge's Institute, Poplar St., Valparaiso, Ind.

PLANS 18 Distance Crystal sets, SW record 4800 miles, with "Radiobuilder"—year, 25c. Laboratories, 7700-T East 14th, Oakland, Calif.

RADIO kits—\$3.95 up. Single band; all wave, 5-10 tubes. Save 50%. McGee Radio, EP-10, Kansas City, Mo.

AMATEUR Radio licenses, complete training in code and theory. American Radio Inst., 1123 Broadway, New York.

RADIOS: All types. Catalog free. Autocrat-B, 3855 North Hamilton, Chicago, Ill.

RARE COINS

QUICK Cash for your old coins. We pay big prices for wanted coins; certain 1909 cent, \$10; liberty head nickels before 1914 \$500; 1864, 1865 Indian head cents \$100 each; dimes before 1895 \$600; some worth \$6,000 each. Have you valuable coins in your possession? It will pay you to be posted—Send 15c for our illustrated coin catalog. National Coin Corporation, Uninc. (3), Daytona Beach, Florida.

COMMEMORATIVE \$½, Columbus, Lincoln, Stone-Mountain, Cleveland, \$1.00 each. Retail catalogue 10c. Norman Shultz, Salt Lake, Utah.

FREE: Foreign coin, banknote, and large illustrated coin catalogue. Send 4c postage. Coin approvals sent. Tatham Coinco, Springfield-D50, Mass.

WE purchase all Indianhead pennies. Purchasing catalogue 10c. Edward Waltman, 460 Grand St., New York.

ILLUSTRATED Coin catalogue 10c. 2000 Quotations. (Not a buying list). James Randell, 407 South Dearborn, Chicago.

BRILLIANT—1939-S or 1939-D uncirculated cent and catalogue 10c. Landon, 901-B Lucerne, Los Angeles.

15 NICE Coins. 25c. 500 East 8th, Kansas City, Mo.

REFRIGERATION

BUILD your own cold-storage. Instructions, material, furnished by 10 yr. exp. ref. Engineer; low prices. Any problem answered, 50c. Write L. Miskella, Box 612, Olympia, Wash.

USED Electric refrigerators, compressors, motors. Wholesale Prices. Experiment, 10023 Freeland, Detroit, Mich.

ROCKS & MINERALS

BEAUTIFUL banded Calcite in white, grey, blue and brown markings. Cuts easily, polishes nicely. Five different specimens, about 2 lbs. each, postpaid in U. S., only \$2.00. Louis F. Bedier, Green River, Utah.

RUBBER STAMPS

3 LINE Stamp 25c; 100 pencils with one line advertisement \$2.00. Printrite, Wauwatosa, Wis.

CUSHION Mounted 2 lines 25c—3 lines 35c. Signatures \$1.50. Stamp Works, Hastings, Nebr.

CLEAR Cut-Cushioned 3 lines 35c. Augustin Stamp, Fond du Lac, Wis.

DEEP letters! Two lines 25c. 3—35c. Ad-Crafts, LaCrosse, Wis.

SONGWRITERS

SONGWRITERS—Write today for free booklet "Building an Income Thru Songwriting." Songwriters Institute, 1234-J Broadway, New York.

WANTED. Poems, to be set to music. Submit for consideration. Transcription records made. Keenan's Studio, P. B. Box 2140, Bridgeport, Conn.

ORIGINAL poems, songs wanted for immediate consideration, publication. Music Corporation, Dept. N-16A, Portland, Ore.

FREE, inspiring booklet describing songwriting opportunities. Allied Music, Dept. 5, Box 507, Cincinnati, Ohio.

SONGWRITERS! Words, melodies. Amazing offer. Hibbler, C-15, 2157 No. Avers, Chicago.

SONG Poems wanted. Free examination. McNeil, Master of Music, 510-PS South Alexandria, Los Angeles, Calif.

RECORDING Songs, poems; Dollar per minute. Ray Turner, Hotel Tilden Hall, Champaign, Ill.

SONGWRITERS Wanted. Work guaranteed. Publication. Great Eastern, 40PS4, Thomaston, Maine.

SONGWRITERS: Send your poem today for immediate consideration. Richard Brothers, 146 Woods Bldg., Chicago.

SONGWRITERS. Verse or music. Brilliant opportunity—Write immediately. Van-Buren, B48, Rockhaven, Ky.

SONGWRITERS: Send poems; free plans, reports. Variety, Dept. G, Salem, Ind.

SPORTING GOODS, GUNS, FISHING TACKLE, ARCHERY

HUNTING, fishing, trapping, outdoor equipment. Used guns. List and catalog free. Howe Fur Company, Coopers Mills, Maine.

SINKER Molds—many sizes and styles. Free illustrated folder. Reading Instrument Co., Box 78, Reading, Pa.

ARCHERY Supplies, Instruction book and catalogue 10c. Mid-West Archery, 2209-D East 75th, Chicago.

FREE to Fishermen—Get the exciting new 1940 Richardson Rod catalog—replete with colorful illustrations and descriptions of genuine Richardson Rods. These rods are built especially for the waters you plan to fish. Their sturdy, lightweight construction—"just right" flexibility and balance—make them universal favorites with real dyed-in-the-wool fishermen. Every genuine Richardson Rod is tagged with the "Sign of the Fish" which explains its outstanding features. Write today to Richardson Rod and Reel Company, 3179 N. Sawyer Ave., Chicago, Ill.

TENNIS Strings direct from manufacturer at low prices! Rush postal for Free complete price list gut and silk tennis, badminton, squash strings. Manufacturing gut strings since 1916... now selling direct to players, re-stringers. Split gut from \$1.60 to \$2.50. Write: H. E. Wills Company, 1047 West 47th St., Dept. PS-400, Chicago.

GUNSMITHING readily learned at home. Repair personal and neighborhood's firearms. Free catalog 20 firearm and gunsmithing textbooks. Tom Samworth, Marines, North Car.

TENNIS Restrung frames, gut, silk. Free catalog. Tennis Supply, 1407½ Sixth Avenue North, Minneapolis, Minn.

STAMP COLLECTING

FREE—Entire issue of "Famous Americans"—This new issue of United States commemoratives consists of 35 stamps to be issued at the rate of 5 stamps every month. We will send Absolutely Free this entire issue to collectors on our active approval mailing list. We'll also send at once for only 10c an attractive, specially prepared album for this magnificent issue, which contains, besides spaces for each stamp, the history and achievements of the 35 great Americans. Send 10c for that album today. You will receive it by return mail together with a splendid approval selection. Globus Stamp Co., 268 Fourth Ave., New York City, Dept. 217.

FREE! World's smallest triangle, Bolivia triangle, gigantic diamond-shaped airmail, diamond-shaped Costa Rica bicolor, War packet—Finland, Russia, Danzig, Poland, Czechoslovakia, Asiatics. Packet old United States, set twentieth-century Philippines, packet fantastic countries—Devils Island, Congo, Cannibal land, Wurtemburg, West Indies, South seas, Kouangtcheouwan, Br. Cols, Junglelands, includes pictorials, commemoratives, airmails, bicolors. Perforation gauge, millimeter scale. Unbelievable—Everything 3c postage. Approvals. Davidson, 2297-S 6E, Salt Lake City, Utah.

STAMP Outfit free! Scarce airmail triangle from the Mozambique Co.; genuine North Borneo (Buffalo Transport); fine packet Jungleland Countries only (a real thriller) including Sarawak (White Rajah), Belgian Congo, Perak, Sudan (Desert Scene), etc., also set U. S. stamps (50 years old!) and extra Surprise Gift—this big outfit absolutely free with dandy approvals and lists! Send 3c for postage. Midwood Stamp Company, Dept. 5R, Midwood Sta., Brooklyn, N. Y.

FREE! The Stamp Finder! Send today for big new edition, fully illustrated, enabling you instantly to identify all difficult stamps! Also fine packet strange, fascinating stamps from Bosnia-Herzegovina, Monaco, Patiala, Cyprus, etc., including maps, ships, animals and strange scenes. All free to approval applicants inclosing 3c postage. Garcelon Stamp Co., Box 918, Calais, Maine.

NEJD (Saudi Arabia)—Bolivia Eucharistic Triangle, Cayman Island Pictorial, Negri Sembilan, Turks & Caicos Islands, Manchukuo, Bahamas War Provisional, Five Dollar United States, British Solomon Islands (Cannibal land). Everything 3c with our famous approvals. Viking Stamp Co., 1-P Hanson Place, Brooklyn, N. Y.

WORLD'S Smallest airmail—largest map diamond and triangle stamps, free stamp magazine, magnifier to study stamps, with large packet of stamps from many countries. A bargain 5c with approvals. Capital Stamps, Dept. 10, Little Rock, Ark.

SCARCE Diamond airmail! Wonderful packet 115 different from strange countries. British Colonies, Haiti, Tasmania, pictorials, etc. 5c to approval applicants. Reliable Co., Box 139D, Church Street Annex, New York.

SIX dollars for 9c! 300 different stamps (Cat. price \$6.00) only 9c with approvals. Tatham Stamp Co., Springfield-50, Mass.

PENNY Approvals that satisfy. Neil Gronberg, Box 5441S., Philadelphia, Penn.

PACKETS—All different—100 Asia 30c, 50 Italian Colonies 45c, 30 Liberia 50c. Entire lot \$1.00. Price list free! Stanley Melzer, 3120 South Adams Ave., Milwaukee, Wis.

COLLECTORS: Fine United States and foreign stamps including airmails, commemoratives, postage on approval. Harvard Stamp Co., 318 Harvard St., Brookline, Mass.

ALL-AMERICAN Bargain approvals: Applicants given 100 different South-Central American collection for 10c. Without approvals 25c. Davis, (APS), Silver Lake, Ind.

STAMP Magazine free—Breezy, authoritative, articles on new issues, questions and answers, philatelic subjects. Sample copy Philatopic Monthly free. Empire Stamp, Dept. P.R., Toronto, Canada.

FREE—World's only octagonal (eight-sided) set and 25 different Japanese pictorials to approval applicants. Charles Cleaveland, 806 North Humphrey, Oak Park, Ill.

UNPICKED Mixture: 40c pound. U. S.: 150 different, 50c; 100 revenues on documents, 10c. (700—50c). Vanvoorde, Hyndman, Penn.

50 DIFFERENT, fine U. S. including perforation Gauge, 10c with approvals. The Stamp Shop, 813 Holland Building, St. Louis, Mo.

500 FOREIGN mixed stamps; absolutely unpicked; many interesting: Only 10c with approvals! Saxon Company, 408-B Jay St., Brooklyn, N. Y.

ELUSIVE Imperforate triangular miniature sheet with 100 different stamps—10c. Friendly Filatelists, Box 4428P, Philadelphia, Penna.

FREE! Select 10 stamps from our approvals free. Just send names, addresses 2 active collector friends. Ranger Stamp Co., Dallas, Texas.

ECUADOR Stamps of New York and San Francisco World's Fair. Also 50 different stamps, 5c with approvals. Libby Stamp Co., Station P, Box 43P, Brooklyn, N.Y.

HEROIC Finland, Scandinavia, 70 fine different, 10c. Includes commemoratives, officials. Morse, 1116 Park, Albuquerque, N. Mex.

NUDE Duchess, Hindenburg Zeppelin, transatlantic airmail commemorative, 5c—Approvals. Laurence Shultes, Berne, N. Y.

50 DIFF. British Colonials 5c, with approvals. Clarence Coleman, North Wales, Penn.

FREE, 25 different Poland; 3c postage, approvals. Elliston, 2841 West 37th, Brooklyn, N. Y.

50 FREE, Iraq, Iran, etc., Catalogued \$1.00. Album 3c. Bullard, 268D Northampton, Boston, Mass.

1000 QUALITY mixed United States 18c. 2 pounds \$1.00. Halay, 452 West 58th, New York.

PERU. Special introductory offer. 108 different \$1.00. Mutze, Lima-Peru, AP-1553.

5 TRIANGLES. 100 World. 10c. Approvals. Ransom, 1333 Pontiac, Ann Arbor, Mich.

PENNY approvals. Thousands different. Pictorials, commemoratives. Raymax, Station Y (21-X), Brooklyn, N. Y.

EXCHANGE your duplicate stamps. List, Swappers, dime. Registrar, Box 2166, Denver, Colo.

MONTHLY Approvals, 100 different 10 cents to applicants. S. Dusenberry, 605 Crocker, Daly City, Calif.

50 DIFFERENT Netherlands 10c approval applicants. Hermes Stampco, Box 276, Hempstead, N. Y.

FREE—Goya Nude or 101 different with approvals. Enclose postage. Jarratt Stamps, 2308 Glennhaven, Houston, Texas.

1000 U. S., including commemoratives, precancels, 15c. Foreign approvals. Lee, Bridgeport, N. Y.

140 CONGO, Sembilan, Palestine, Siam, Bosnia, Paraguay, etc. 10c. Lufbery, Middletown, Conn.

103 DIFFERENT beauties, includes scarce Canadian Royal Visit complete 10c. Wallace Mitchell, Box 139, Cambridge, Mass.

SHOE Box full of stamps, foreign, U. S., remainders collection sheets, etc. One dollar. Pickwick, 80 Wall, New York City.

FREE! 100 Foreign stamps and "What Every Stamp Collector Should Know." Max Pyka, 3118 Fullerton, Chicago, Ill.

FREE! Austria war set. Postage 3c. Williams, 601 Archerldg., Baycity, Mich.

WE Repeat! 125 mixed stamps 3c approval applicants only. Quality Stamps, Englewood, Colo.

FREE! Two coronation sets. Postage 3c. Roberts, 312U Shearer Bldg., Baycity, Mich.

HINDENBURG Zeppelin set complete 3c approvals. Thode, 14302—119 Ave., Jamaica, N. Y.

UNITED STATES \$4 and \$5 stamps Free to approval applicants sending 5c for 100 all different. Wineholt, Woodbine, Penna.

TWELVE desirable airmails 5c. S. Barker, 714 Market, San Francisco, Calif.

1/4 POUND worldwide or U. S. mixture 10c. Efker, Anaheim, Calif.

200 DIFFERENT, 5c. Approvals. P-S Company, Box 2154, Houston, Texas.

150 GOOD mixed foreign stamps, 5c coin. Stanton, Niantic, Conn.

100 U. S. 1861-1908, 25c. Imperforate Free. Weston, Box 383, Ponca City, Okla.

PENNY Approvals by country. M. H. Hoerning, Merriam, Kansas.

THREE sets for three cent stamp! Jack Reed, Houtzdale, Penna.

25 DIFFERENT Latin America only 10c. Burkhardt Stamps, Sandwich, Ill.

TEN different United States over 40 years old, 10c. Elzea, Bowling Green, Ohio.

1,000 FOREIGN mixed 25c. Lincoln Hobbes, 173 Columbia Ave., Irvington, N. J.

SURVEYING INSTRUMENTS

GUARANTEED Factory rebuilt transits and levels for rent (with purchase option) or sale (cash or terms). We will repair, trade in, or buy your old instruments. Ship prepaid for cash valuation. Write for list PS54 and complete information to Warren-Knight Co., 136 North 12th St., Philadelphia, Pa.

TATTOOING SUPPLIES

TATTOOING, Engraving, Outfits. Illustrated list free. Percy Waters, Anniston, Ala.

TELEVISION

TELEVISION Tubes—Motors; Disks. Arthur Pohl, 4829 Merritt, Detroit, Mich.

TYPEWRITERS, OFFICE DEVICES

TYPEWRITERS, adder, mimeograph, multigraph, addressograph. Send for free lists of machines that will help you at half price. Pruitt, 28 Pruitt Bldg., Chicago.

WANTED—MISCELLANEOUS

CASH for used microscopes, binoculars, slide rules, drawing sets, scientific instruments, tools, cameras. Satisfaction guaranteed or shipment returned. Elman's, 2300-PS VanBuren, Chicago.

WILL buy your unused United States stamps. Small discount. What have you? Mint Sheet Brokerage Co., 423 Paxton Bldg., Cleveland, Ohio.

WATCHES

WATCHMAKERS' Materials: tools; watches; jewelry. Bought, sold, exchanged. Wholesale catalogue. Ben Segal Company, Mallers Bldg., Chicago.

WELDING, SOLDERING

D.C. ARC-WELDER plans \$1.00 each (three for \$2.00). Build it yourself without rewinding armature. 25-200 amperes from farm light plant generators. 25-200 amperes from Northeast. Dodge automobile generators. 25-600 amperes from d.c. vehicle motors originally storage battery driven. Welders Club, WB-3432 M-Mart, Chicago. For Sale: D.C. vehicle motors, supplies, etc.

BUILD your own electric welder for operating from storage battery. Simplified plans and 1940 catalog 10c. LeJay Manufacturing, 623 LeJay Bldg., Minneapolis, Minn.

REBUILT Welders. All sizes. Engine or electric drive. No junk. Fully guaranteed. Low prices. Terms. Service Co., 3732 Cedar Ave., Cleveland, Ohio.

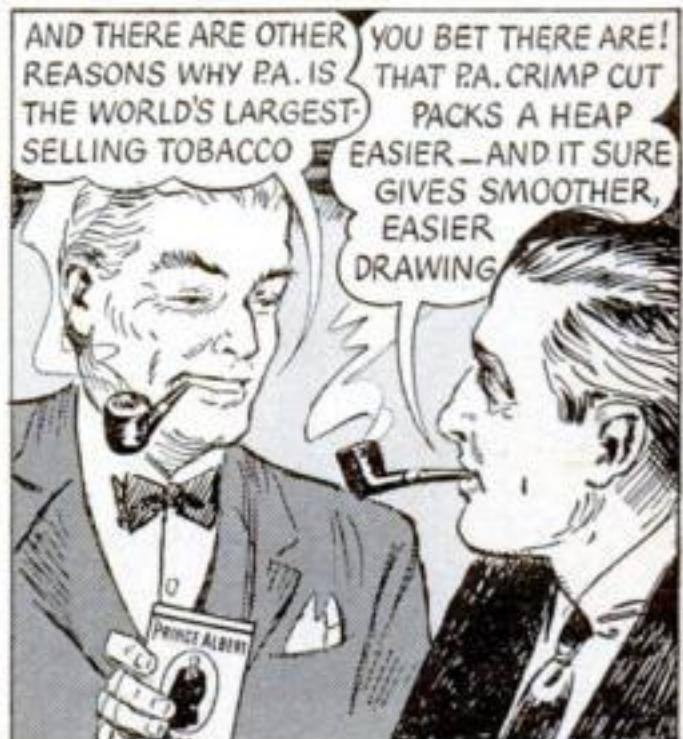
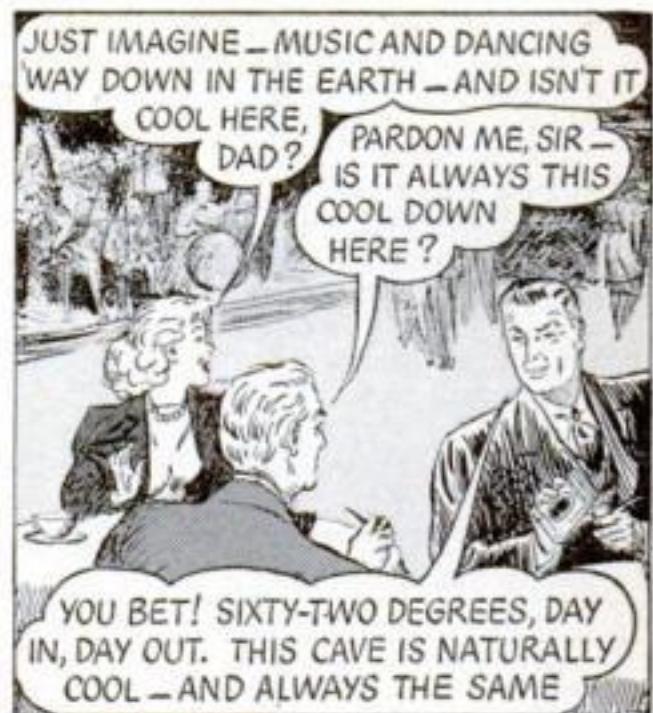
BARGAINS, Demonstrator Arc Welders, gasoline and electric drive. Liberal trial, easy terms. Write Hobart Welder Exchange, Box P-4402, Troy, Ohio.

BUILD AC welder to cut or weld. Plans for three sizes, \$1.00. Information dime. Hi-Point Electric Products, Bellefontaine, Ohio.

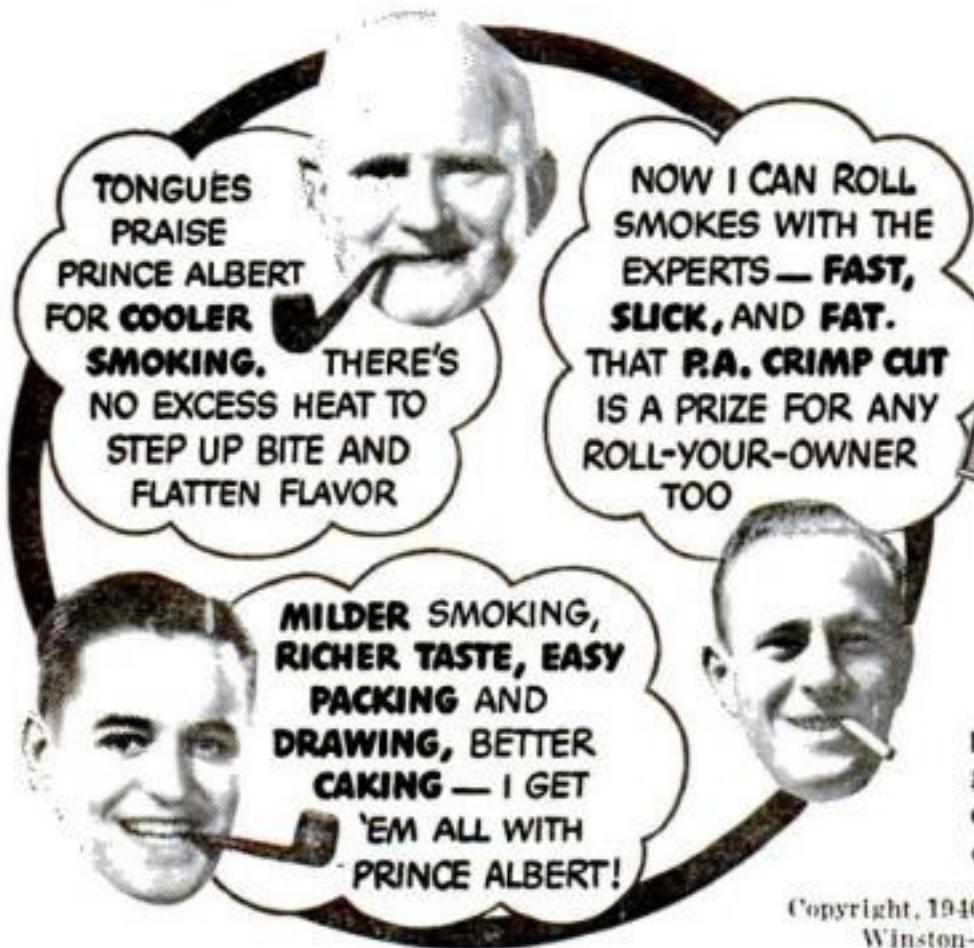
ACETYLENE Welding generators, latest type. \$25.00. Johnson Generator Co., Brookfield, Mo.

110-220 VOLT arc welders, helmets, plans, material. Holgerson, Canton, Kansas.

OL' JUDGE ROBBINS



HERE'S YOUR PASS TO THE **SMOKE-JOY CIRCLE**



50

pipefuls of fragrant tobacco in every handy tin of Prince Albert

Prince Albert
THE NATIONAL JOY SMOKE

Copyright, 1940, R. J. Reynolds Tobacco Co.
Winston-Salem, North Carolina

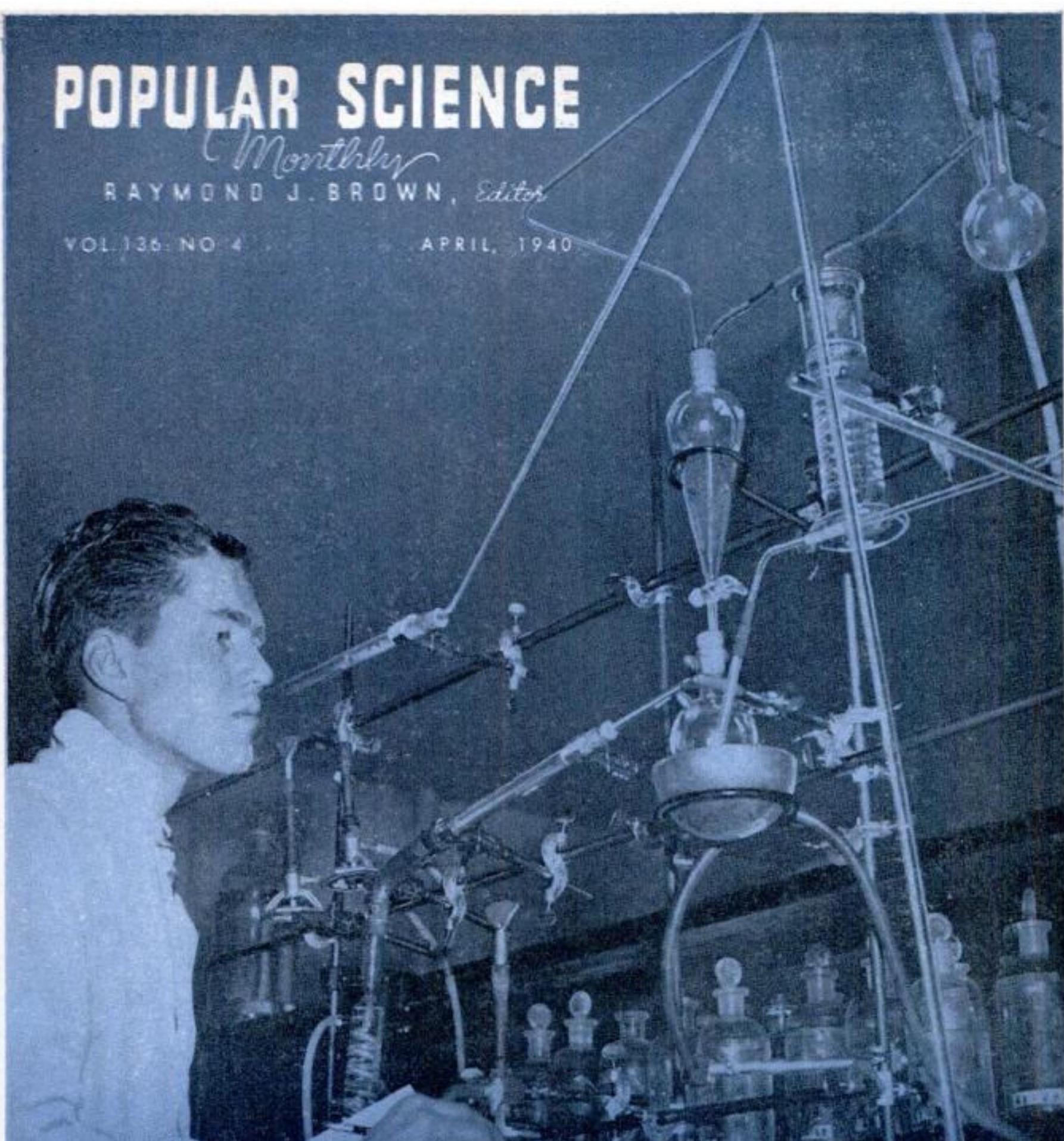
POPULAR SCIENCE

Monthly

RAYMOND J. BROWN, *Editor*

VOL. 136. NO. 4

APRIL, 1940



Super-fuels already are a laboratory reality. All that remains now is to reduce their cost.

Super-Gasoline for Your Car

By JOHN E. LODGE

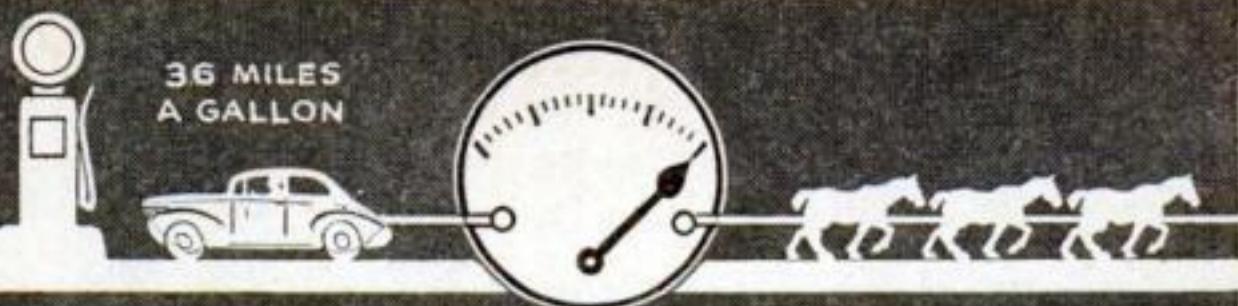
IIFT the hood of one of tomorrow's motor cars and you will have to look twice to find the engine. It will seem like a midget beside the motor of a 1940 model. Yet, such mechanical pygmies will give you

greater power and more mileage than the most efficient engines of today. Super-fuels, just over the horizon, will make possible this magic change.

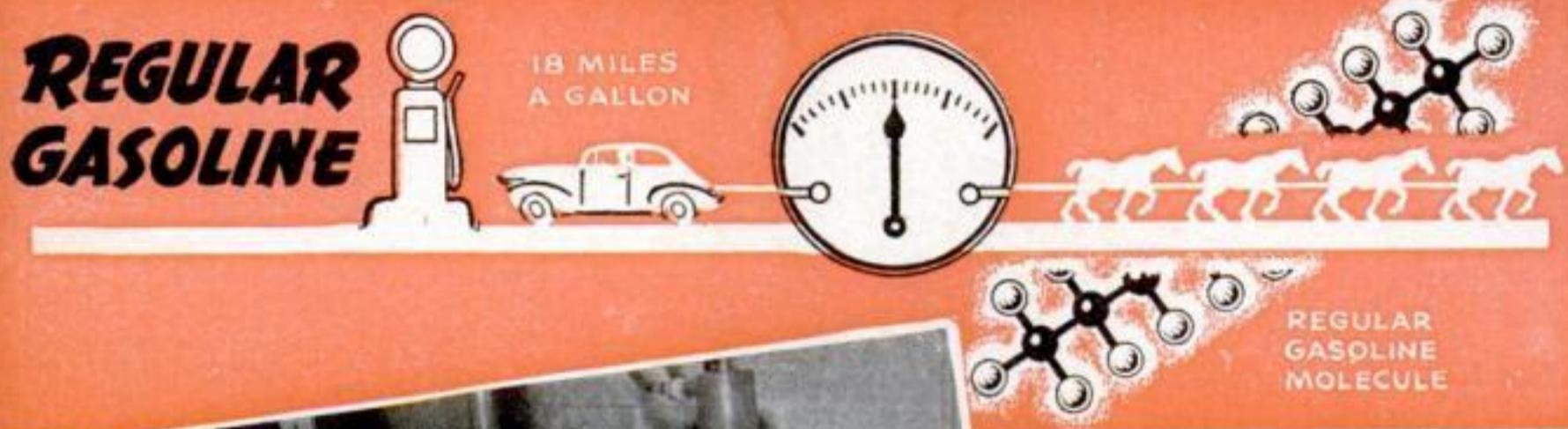
Already, scientists in several American laboratories have held in their hands test tubes and flasks of these gasolines of tomorrow. Their researches have blazed the

**CHEMICAL WIZARDS ARE JUGGLING ATOMS
TO PACK MORE MILES INTO MOTOR FUELS**

SUPER-GASOLINE

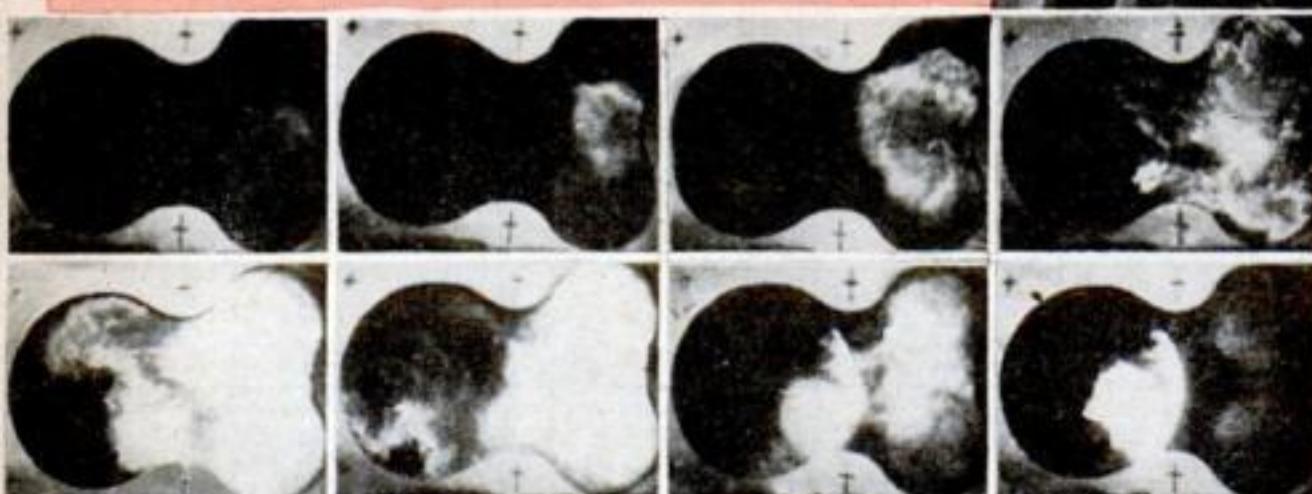


REGULAR GASOLINE

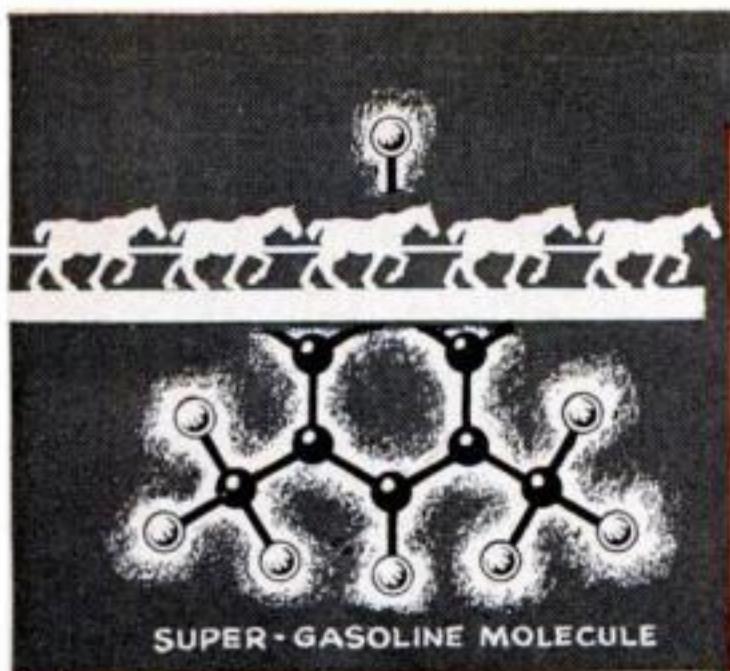


Determining the octane rating, or anti-knock qualities, of a sample of fuel in a test engine. By streamlining molecules, 125-octane-rating fuels have been made

trail to new fuels. The problem that remains is to bring the cost of such gasolines within reach of the average motorist. A little more than a year ago, one of the new laboratory fuels was valued at \$3,600 a gallon. Today, the same super-gasoline could be produced for fifty dollars a gallon. A few years hence, it may be avail-



What happens inside a motor? To find out, experts made the camera above. It snaps actual explosions in a motor, as at left



able at the cost of ordinary fuel, and motorists will get a tidy dividend in increased travel mileage.

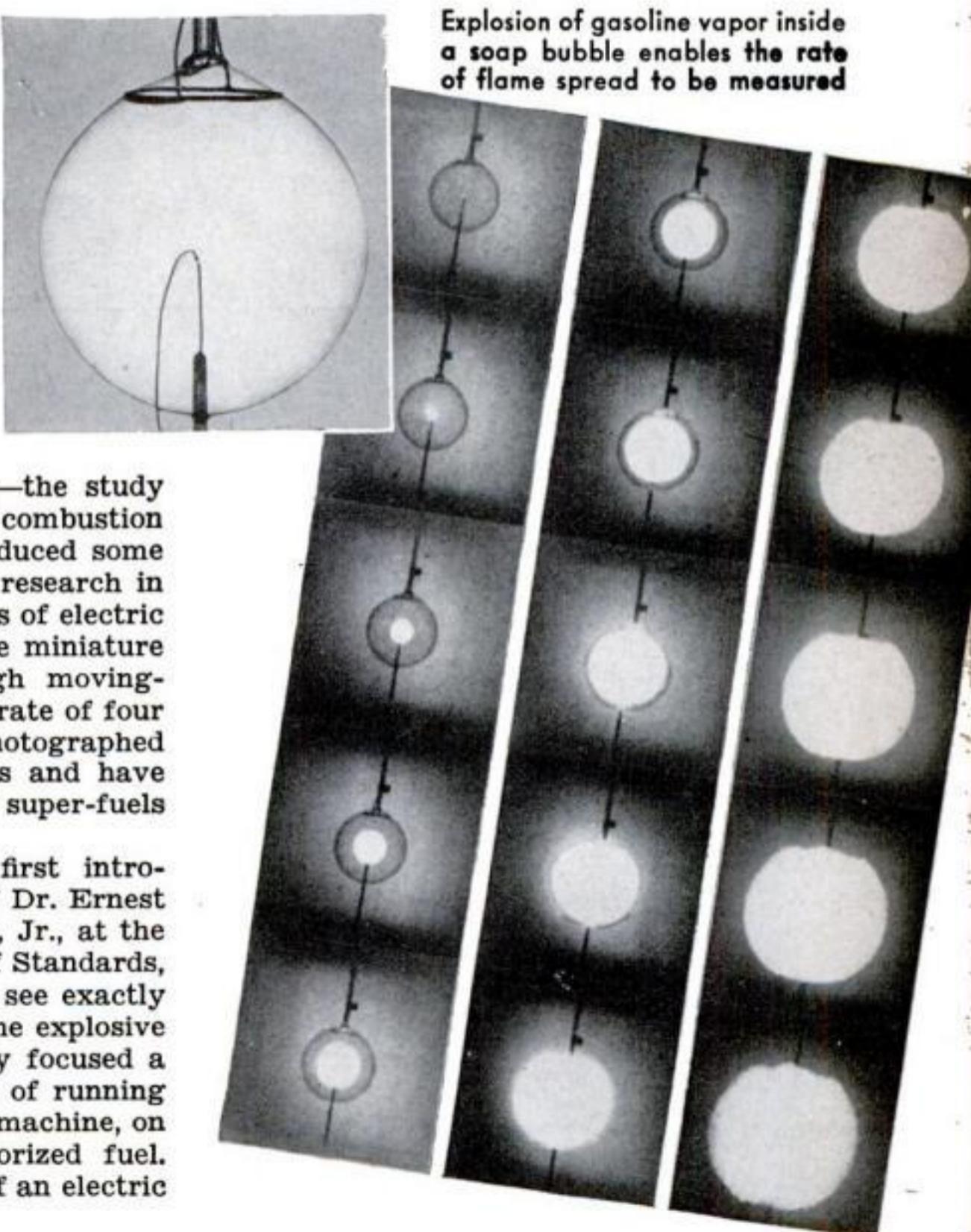
For years, petroleum chemists have known that the fluid we call "gasoline" is made up of a wide variety of volatile, highly inflammable substances known as hydrocarbons. There are 200 different kinds, some more efficient than others, found in different gasolines. Which ones you get in the brand of "gas" you buy, depends upon where it comes from and how it is made. Separating the efficient hydrocarbons from the mediocre ones is a goal of modern petroleum-research experts.

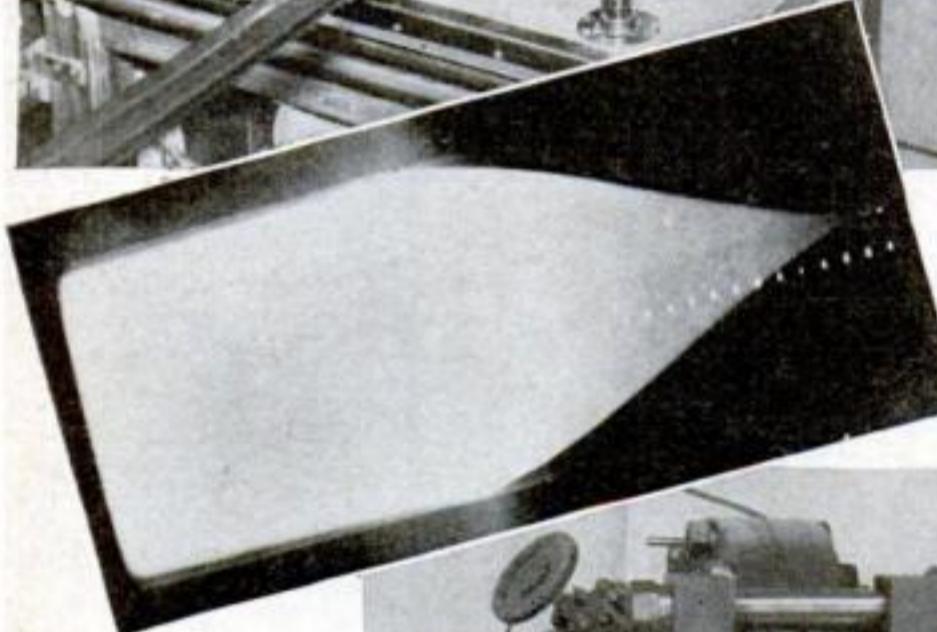
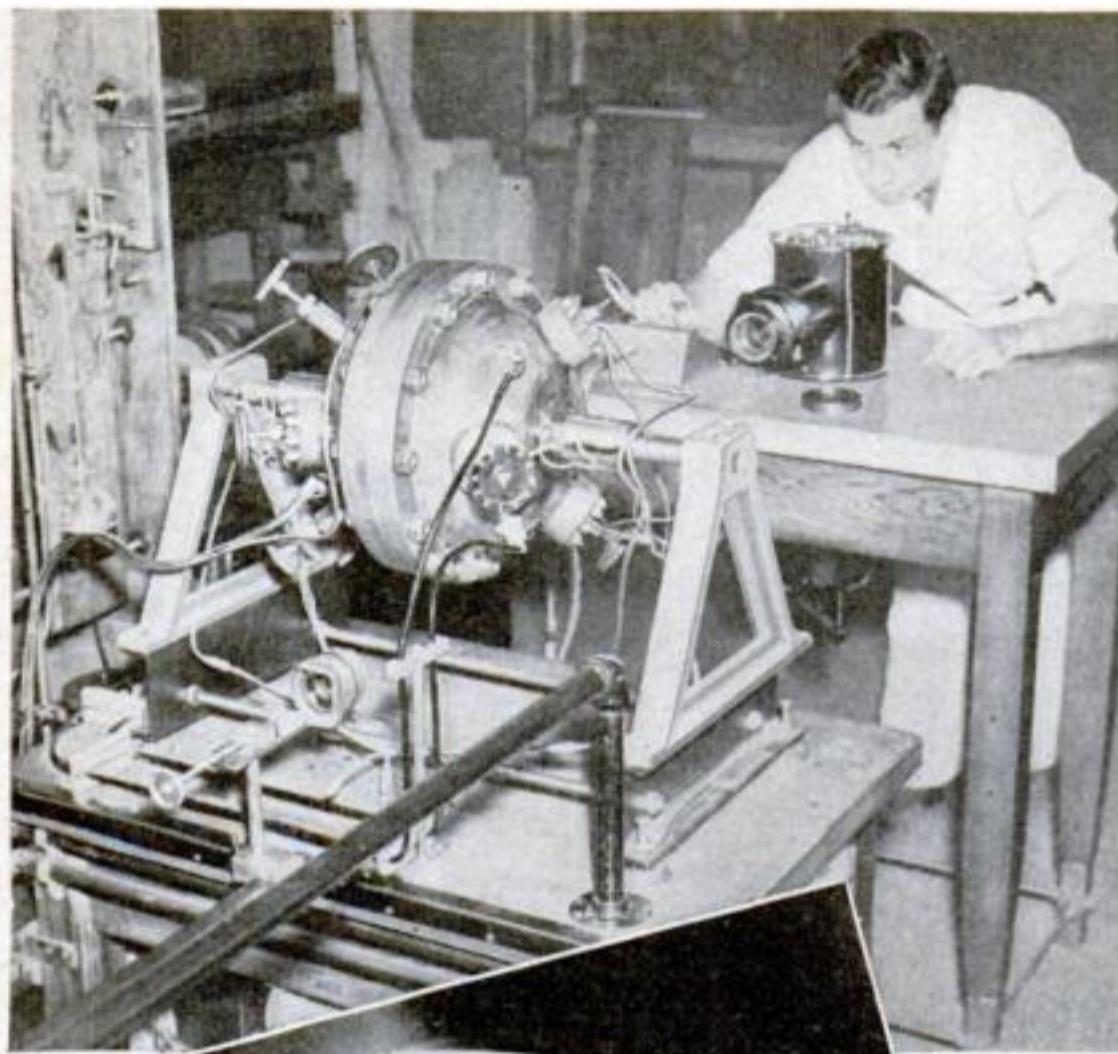
Another line of investigation—the study of how fuels react within the combustion chamber of an engine—has produced some of the most fascinating bits of research in recent years. With glowing tubes of electric fire, soap bubbles that burst like miniature bombs, films that whiz through moving-picture cameras at the amazing rate of four miles a minute, scientists have photographed the explosion of gasoline vapors and have analyzed requirements for the super-fuels they are seeking.

"Soap-bubble bombs" were first introduced during the experiments of Dr. Ernest F. Flock and Charles F. Marvin, Jr., at the laboratory of the U. S. Bureau of Standards, in Washington, D. C. Trying to see exactly how flame progresses through the explosive vapor in a gasoline engine, they focused a moving-picture camera, capable of running 100 times as fast as an ordinary machine, on a soap bubble filled with vaporized fuel. Igniting the mixture by means of an electric

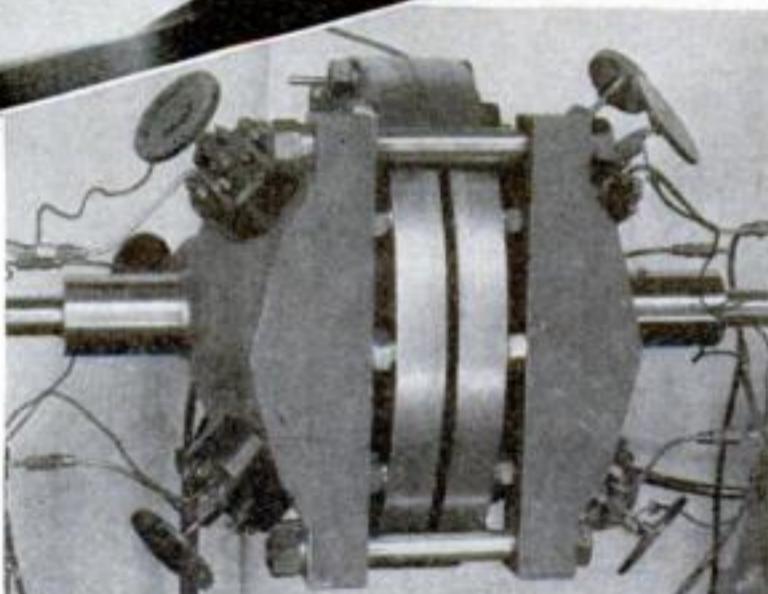
480 MILES ON A GALLON OF GAS?

When the service-station pump rings up a gallon of gas, you are getting enough fuel, engineers say, to run a light car on a level road for 480 miles, if every heat unit could be harnessed by an automobile engine! But the very shape of ordinary gasoline molecules, experts have found, precludes getting much of their fuel value out of them. So laboratory workers are taking the molecules apart and putting them back together in new and better forms. The goal of their researches is graphically portrayed at the left.





How flame spreads through gasoline vapor, as photographed by Dr. E. F. Flock, who is shown above with high-speed camera



spark at the center, they recorded what followed. To their eyes, the bubble disappeared in a flash of light. But to the high-speed camera, the action appeared slowed down so that the split-second expansion of flame within the transparent walls of the bubble was shown as a dilating glare spreading outward from the center. The film thus revealed the rate at which an explosion spreads, through a vapor mixture of unvarying pressure, which was assured by enclosing it in the soap bubble.

An even faster camera has aided W. G. Lovell and J. M. Campbell in their extensive researches at the General Motors Laboratories, in Detroit, Mich. This ultra-high-speed machine can expose a quarter of a

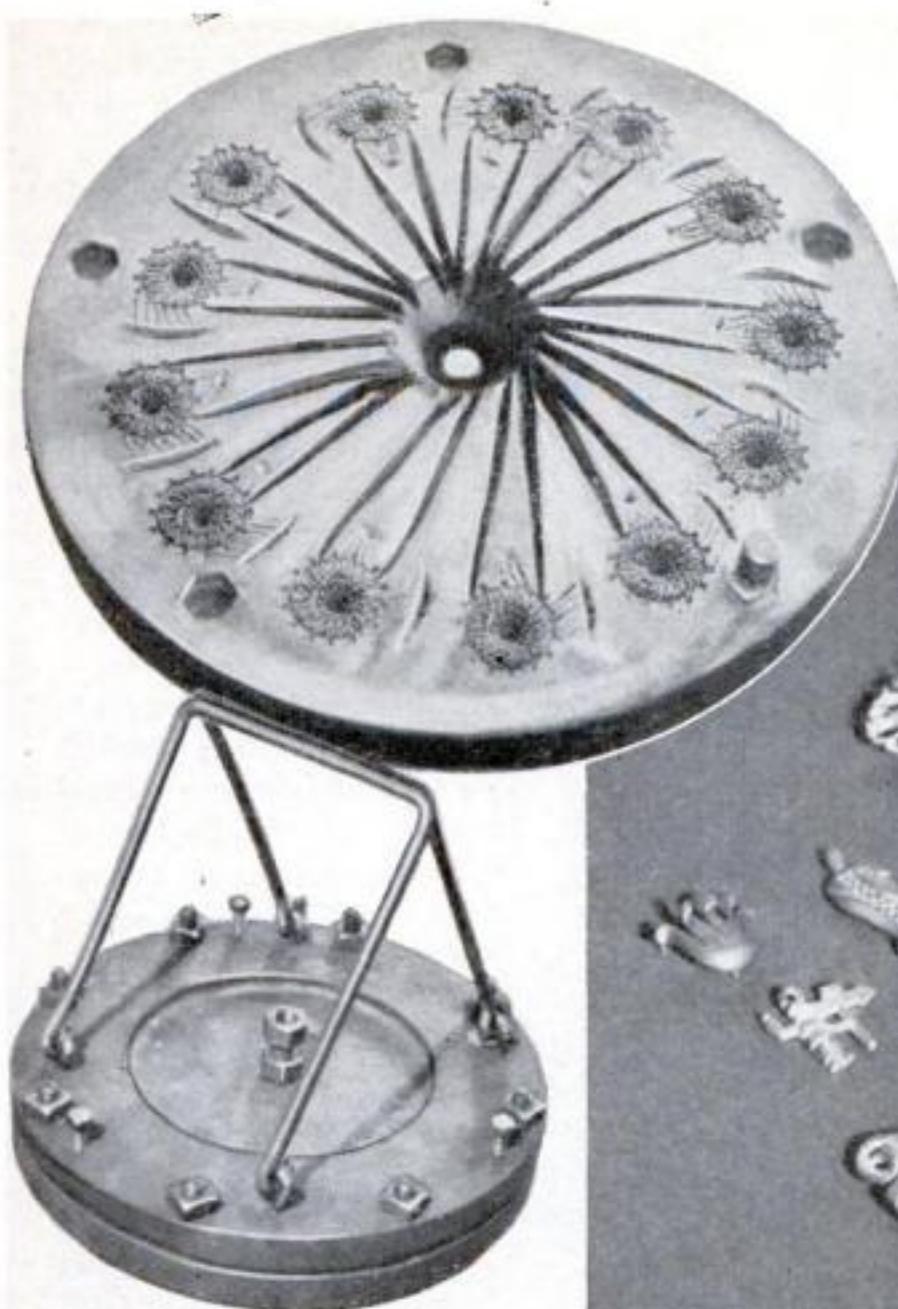
mile of film in four seconds! Equipped with thirty lenses, the camera records thirty pictures of a single explosion, taking the shots at the rate of 5,000 a second!

By replacing the metal top of a motor cylinder with a window of transparent quartz, Lovell and Campbell have been able to use their specially designed camera to record exactly what takes place when the explosion occurs. With the motor running at 2,000 revolutions a minute—a rate corresponding to about forty miles an hour on the road—a single explosion begins, spreads, and is all over within one two-hundred-and-fiftieth part of a second. In that fleeting moment, however, the super-speed camera makes no less than twenty pictures that show every stage of the explosion. Run off at reduced speed in the projector, they give the engineers a perfect slow-motion view of the flame.

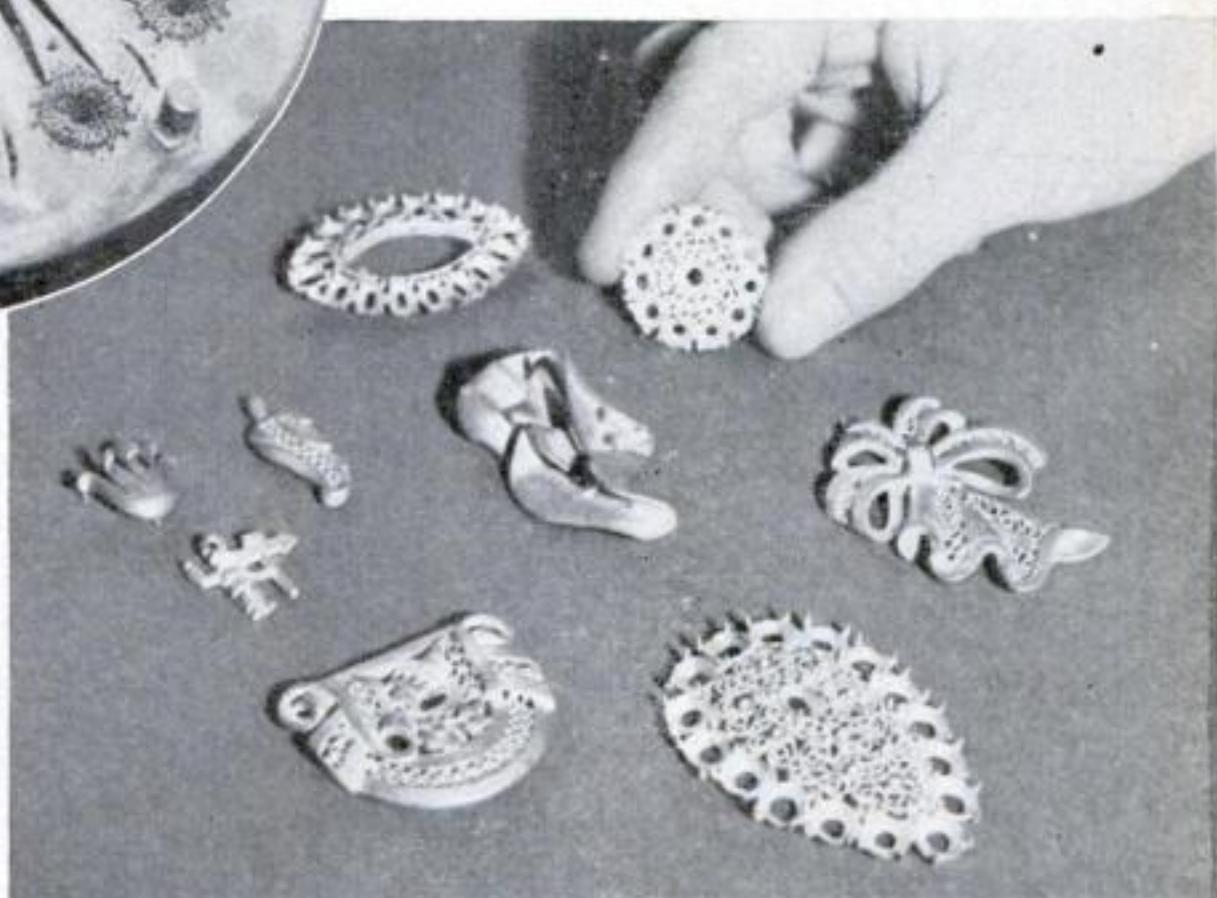
Applying the results of tests like these, engineering experts at Detroit then make plaster models of proposed engines. Varying the shape of the hollowed-out combustion chambers, they arrive at a design which will yield maximum smoothness and power by controlling the speed of the flame in accordance with their experimental findings. The plaster cast then serves as the model for a new engine.

Of all gasoline engines ever built, probably the most pampered is one which has been chugging away in this same laboratory. No ordinary fuel from a service-station pump ever enters its carburetor. Instead, skilled chemists feed it rare and expensive concoctions, prepared and blended as carefully as the contents of a baby's bottle. The experimenters pour the compounds from glass flasks bearing such unfamiliar labels as "toluene," "xylene," and "mesitylene." You could cross out each of these names, and write "gasoline" in its place, and the labels would still be correct. But many of these kinds of gasoline bear about the same relation to ordinary automobile fuel that a form of carbon called the diamond bears to another form of carbon called coal. They (*Continued on page 228*)

Cheap Rubber Molds Cut Casting Costs



Vulcanizer for making a rubber mold. Top, half of a jewelry matrix. Note radiating channels



Samples of jewelry novelties turned out by pouring molten metal into the molds made of inexpensive rubber instead of costly solid bronze



Identical Gloves Fit Both Hands

WITH a new type of reversible leather glove, illustrated above either one of a pair may be worn on either the right or the left hand, since the fronts and backs of the gloves are identical. If a glove is lost, it is not necessary to buy a new pair.

TREMENDOUS savings in the cost of making cast novelty jewelry and small metal parts are said to be made possible by molds made of rubber instead of solid bronze, the usual material. A mold is made simply by sandwiching samples or models of the articles to be cast between two soft rubber blanks which are then forced together and vulcanized. After vulcanizing, the two hardened blanks form the mold.

Unit Tests Stockings for Runs

RESISTANCE of silk hosiery to snagging, the cause of most stocking runs, can now be measured by the device pictured below, a development of the U. S. Bureau of Standards.



Testing stockings' resistance to snags, which cause most runs



As the book's story unfolds, a record accompanies it with words and music

Record Gives Music for Story Book

A "SINGING BOOK" of nursery rhymes for children, just placed on the market, is supplied with a ten-inch, double-face phonograph record that is synchronized with the story. When the record is started on a phonograph, it supplies the sound effects, sings the verses, and tells the reader following the story in the book just when to turn the pages.

Roller Blotter Works Fast



FITTED with forty separate layers of blotting paper, a new roller-type desk blotter will blot the entire surface of a written page in a few strokes, without smudging the writing.



Ring Has Hinged Setting



CONCEALED names, initials, or a short written sentiment can be built into a new type of wedding ring now available. As shown above, the outer diamond setting is hinged to swing open and reveal the letters ordinarily hidden below it.

Lifting the hinged setting reveals the concealed lettering

Paint Shatterproofs Ordinary Glass

WHEN applied over ordinary glass, a new transparent paint now being produced in England is said to prevent the glass from splintering if accidentally broken. When struck by a heavy mallet, as pictured above, the paint-treated glass cracks but does not split up into loose splinters as ordinary glass would do.



Julian E. Garnsey, color engineer,
making a color design for a ceiling

How Science Puts Color to Work



Miniature room interiors with interchangeable panels, set into revolving columns, enable home owners and builders to select a pleasing color combination for decorating

Industry, Business, and Medicine Are Making Use of the Rainbow

AT A western hospital, not long ago, attendants wheeled a patient into the psychopathic ward. He was weak, emaciated, hardly able to speak above a whisper. Doctors were afraid he would starve himself to death.

"I won't eat!" he kept repeating stubbornly.

Nothing was said to change the patient's mind. He was simply placed in a large room decorated with crimson and scarlet. Twenty-four hours later, he suddenly rang for an attendant and demanded his breakfast. Something in the new, colorful surroundings had stimulated him out of his fit of depression. He was ready to face life again.

In recent years, scientists have learned dramatic new facts about the magic of color—facts of value in our daily lives. Business

men, advertising experts, and package designers, as well as laboratory workers and psychologists, have added fascinating discoveries to the increasing fund of our knowledge.

For example, when the profit chart in the office of a leading American meat packer took a sudden upward jump, a few months back, officials knew just what was responsible. Incredible as it may seem, it was green sawdust on the salesroom floor!

Not many weeks before, these same officials had been scratching their heads, trying to solve the riddle of why their freshest cuts of meat were drawing bids below the top prices. Finally, they called in a noted New York color engineer, Faber Birren. One look at the salesroom, and Birren put his finger on the trouble.

"Your walls are yellow," he pointed out. "The sawdust on the floor is also yellow. When buyers look from this hue to the red

By ROBERT E. MARTIN

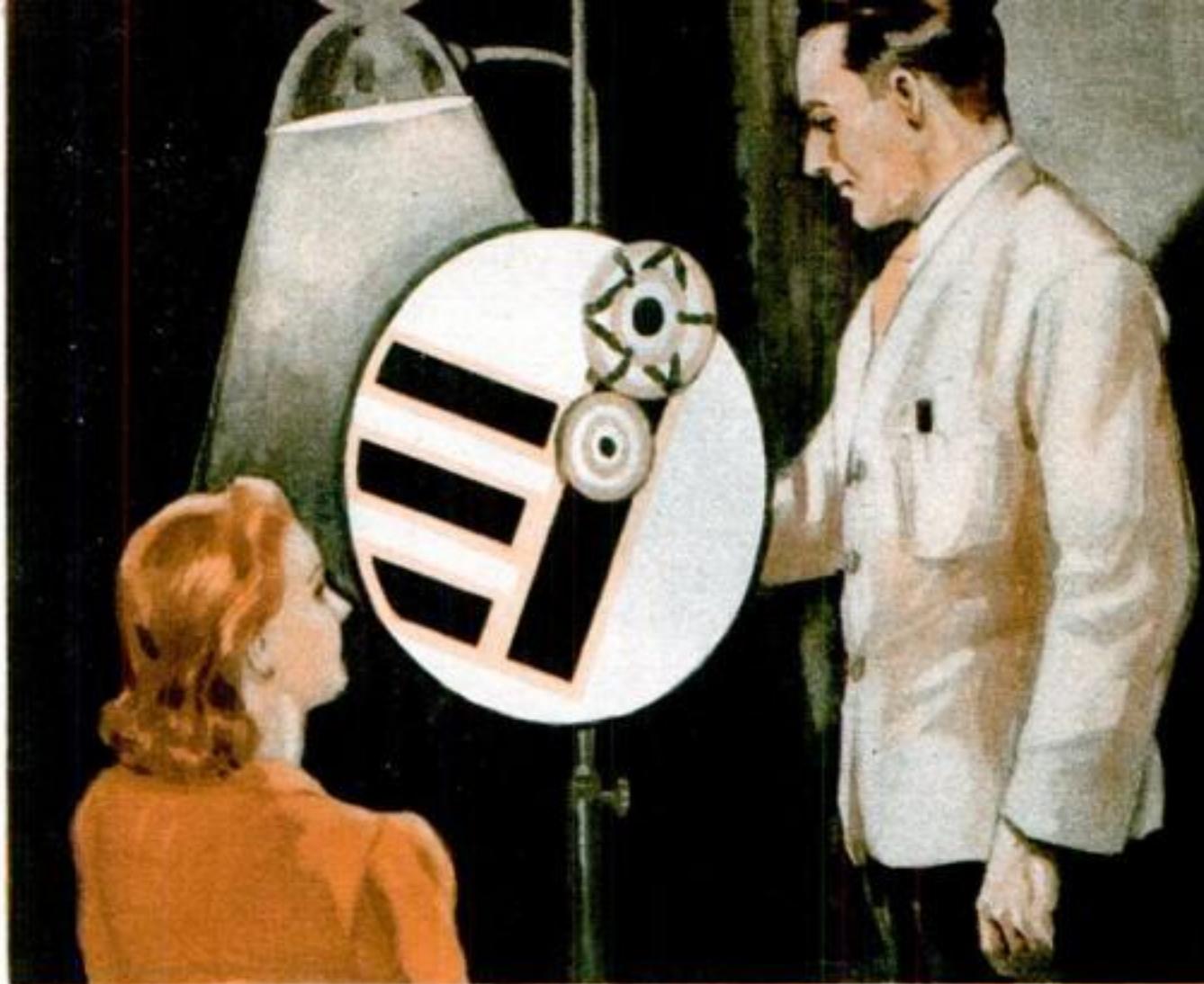
meat, the latter appears dark and discolored. Dye your sawdust green and tint the walls blue. In such surroundings, the buyers will see the meat as it is, bright red and fresh-appearing."

The officials were dubious. But they tried the plan. Hardly a week went by before they were delighted to find that bids were rising. And, today, the company is realizing an average of a quarter of a cent a pound more on its fresh meat simply because it uses green instead of yellow sawdust!

In another recent case, a manufacturer of asbestos shingles boosted his profits more than half a million dollars in one year by adding a slight amount of purple to his dye. Frederic Rahr, an eastern color expert, suggested the change.

Experimental biologists, carrying on researches with birds, fish, animals, and insects, have added remarkable discoveries to the lore of color. They have noted

Stare at the star at the right for about a minute, then quickly shift your eyes to a blank wall or ceiling. In a few seconds, you'll see a natural rose and green leaves appear before your eyes—just the reverse of the colors printed here



This apparatus employs the eye-attracting powers of red to stimulate and exercise the optical muscles as a means of correcting a squint



odd preferences among wild creatures and startling effects of color on their lives. Starlings, for example, are stimulated to breed by red light. Bees, although color-blind to red, can see ultra-violet rays invisible to our own eyes. Humming birds, which are found only in North and in South America, prefer red and yellow flowers. Consequently, because these birds carry pollen from bloom to bloom, certain families of plants to which the birds are particularly partial have more red and yellow flowers in the Americas than in any other part of the world.

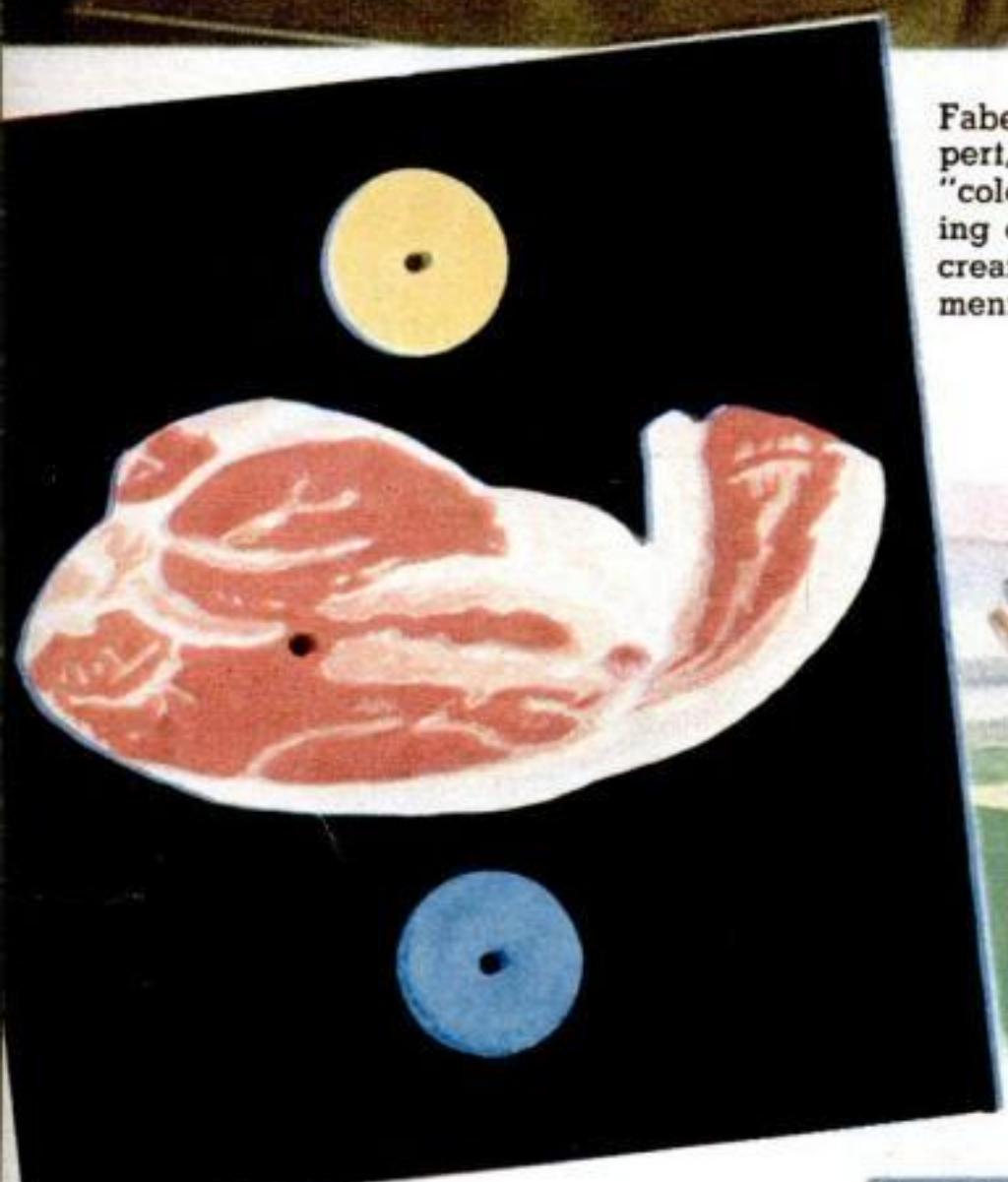
In France, some years ago, a scientist lined a large box with squares



Baiting a trap with color: Blue light lures insects to electrocution in this "bug trap," used to guard fruit orchards



Faber Birren, color expert, demonstrating his "color equation." Whirling disks enable him to create new hues experimentally to test effects

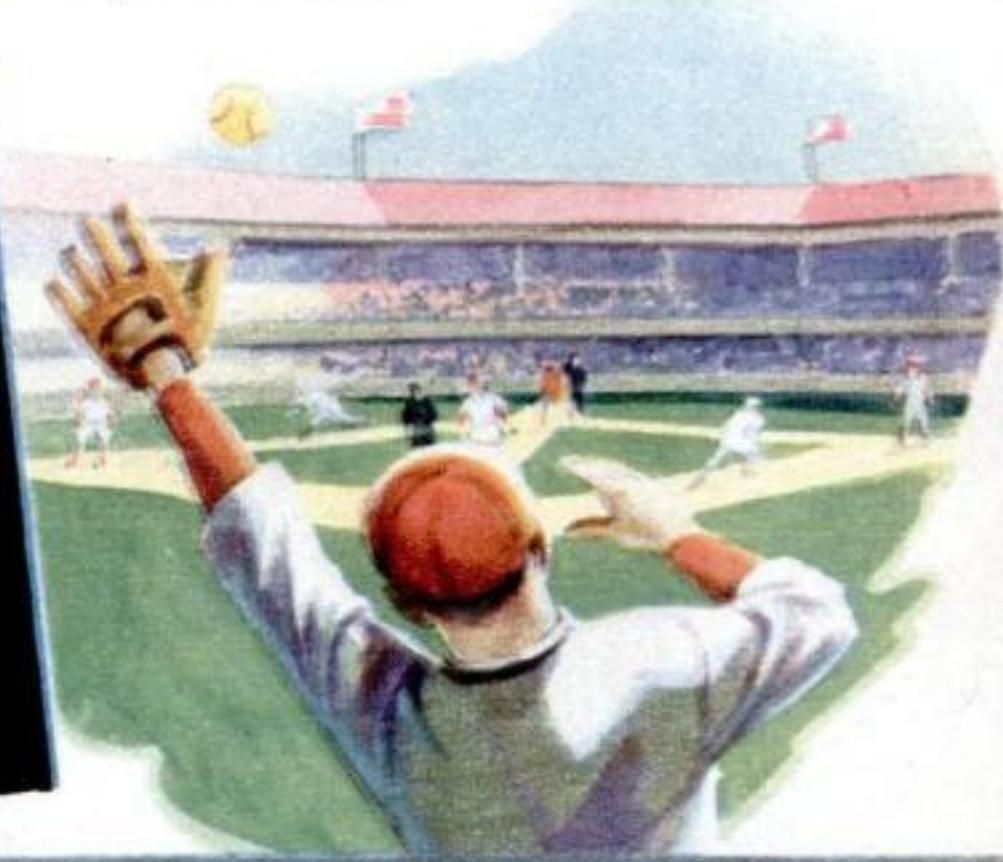


Why green sawdust can make meats look natural: Gaze for a minute at the center of the yellow disk, with the rest of the picture covered, and then look at the piece of meat. Now do the same with the greenish disk, and note how much fresher the meat looks. Right, yellow ball looks bigger

of varicolored paper. Day after day, he counted the number of flies resting on each color. Most of the insects preferred green. Next in order of choice came yellow, azure, red, and ultramarine, or bright blue. His researches had a practical consequence, for the walls of French and Dutch slaughterhouses are now often painted bright blue to discourage flies.

Another discovery in connection with color and insects is finding application in the orchards and orange groves of California. Entomologists noted that night-flying moths fluttered in greater numbers around blue neon signs than around glowing tubes of any other color. So the electric insect traps in California orchards are now being decked out with blue and purple "stop lights" for the bugs that infest the trees.

In various other fields, color research is tackling new jobs. Package designers have found that a skillful use of colors will create the

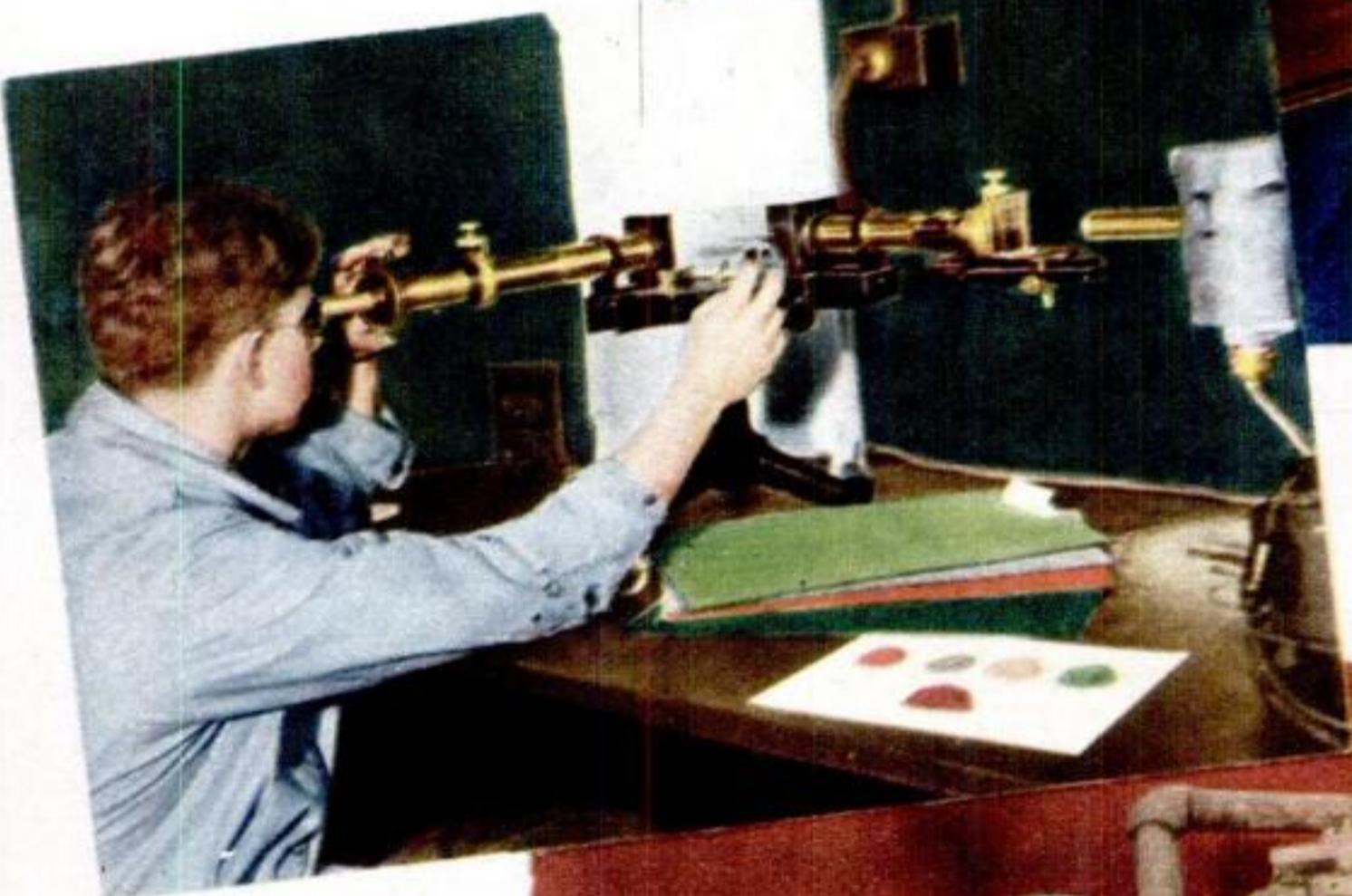


impression that one container is larger than another, though they are exactly the same size. Baseballs that are tinted yellow have been found to be more easily seen against the sky and actually to look larger than the conventional white ones. Such balls are now optional with the umpire in many major-league games.

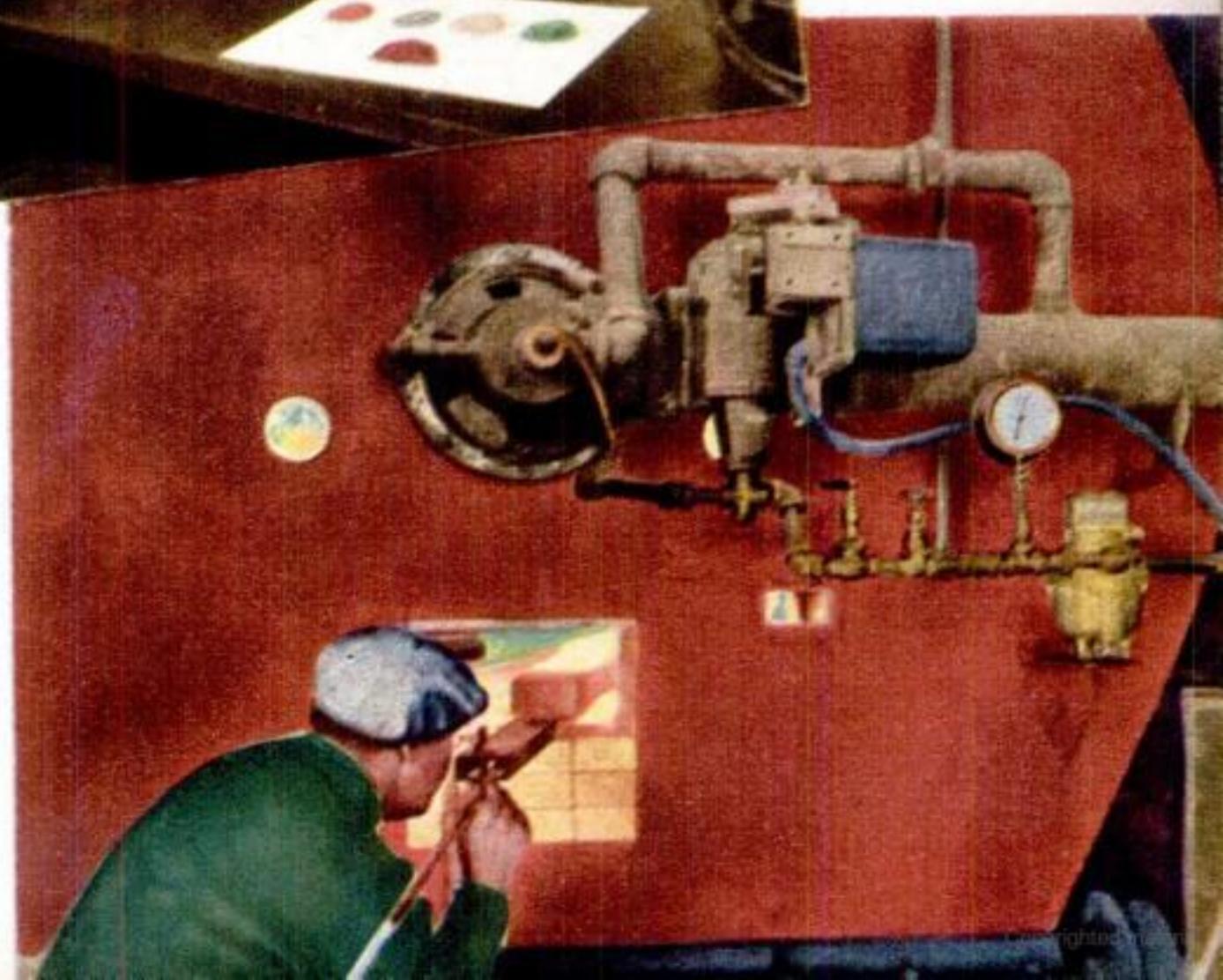
Nearly two centuries ago, a paint manufacturer introduced red paint for barns on the theory that such a coating made the buildings warmer in winter. Science has substantiated his contention. It is now well known that light hues reflect heat waves from the sun, while dark shades absorb them. Hence, we wear light-colored clothes in summer and darker fabrics in the

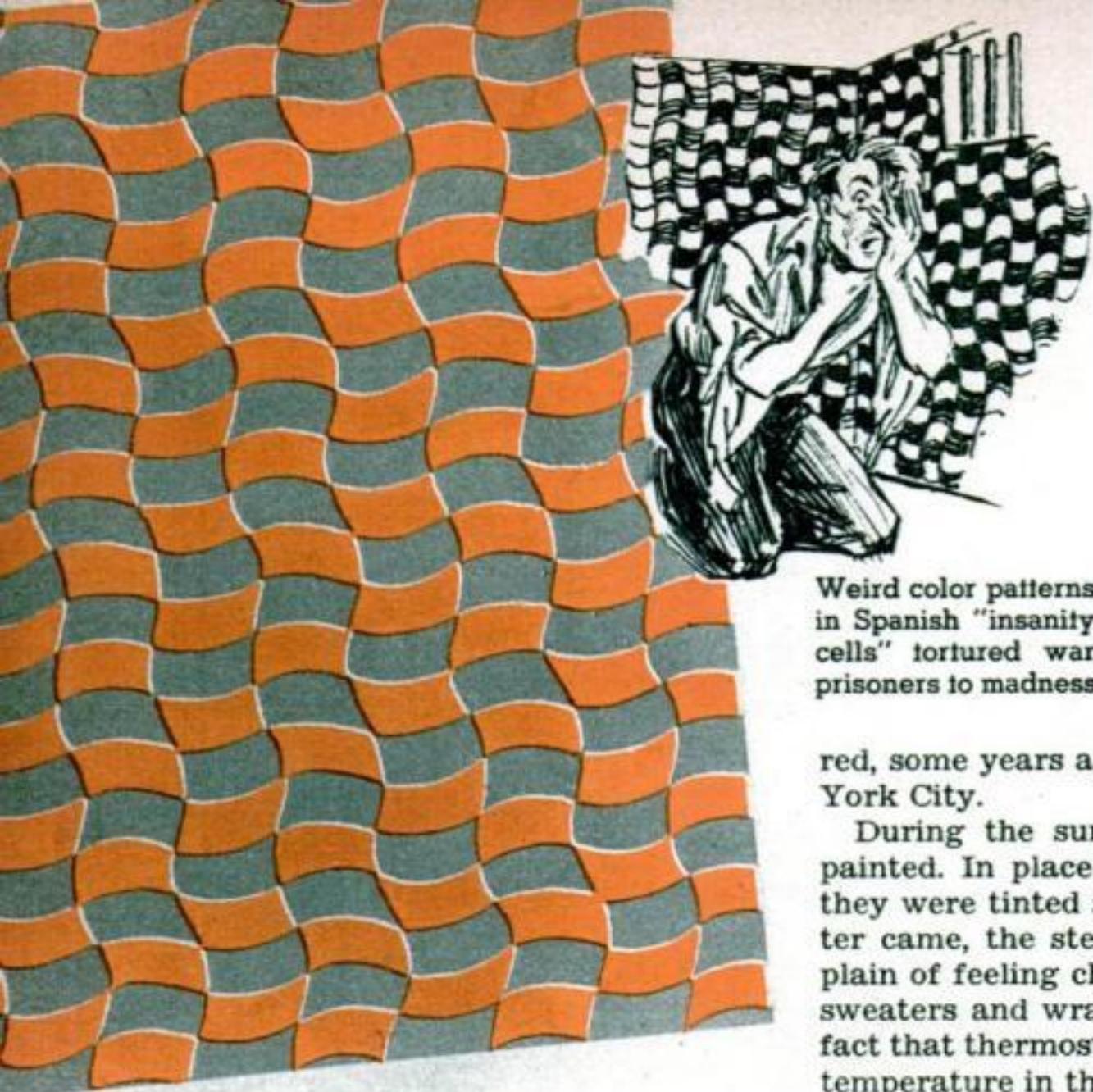


Frederic Rahr explaining how more cheerful colorings in shingles can make life happier



Color solutions for tinting asbestos shingles are checked with this instrument. When correct, the solutions are applied to rock granules, which are baked in kilns like the one at the right. This worker is testing the temperature to make sure that it is exactly right.





Weird color patterns in Spanish "insanity cells" tortured war prisoners to madness

months of cold, when the warmth is welcome.

A striking application of this knowledge recently enabled members of a polar expedition to keep drinking water from freezing while they worked their way across fields of arctic ice. All their water bags were painted black. During the day, these containers absorbed sufficient heat from the sun to raise

the temperature of the fluid inside to sixty degrees F., at times when the air outside was as cold as twenty degrees below zero.

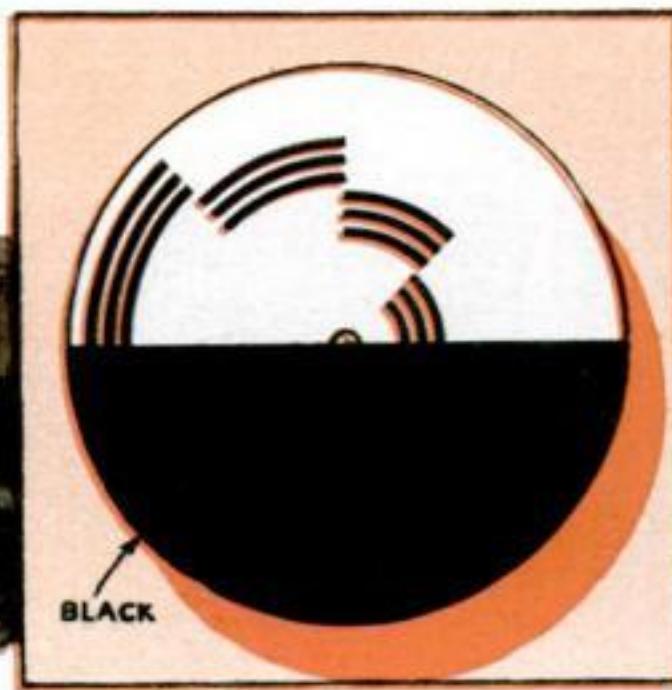
Even when the thermometer in a modern building indicates a constant temperature, office workers in some rooms often feel chilly while those in other rooms feel hot. The cause of this paradox is the color scheme used in decorating. A remarkable example of this fact occurred, some years ago, in a large office in New York City.

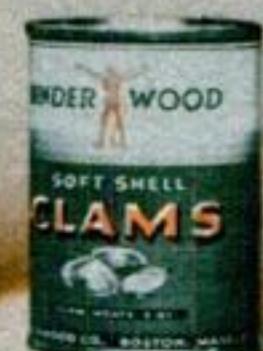
During the summer, the walls were repainted. In place of a warm cream yellow, they were tinted slate blue. As soon as winter came, the stenographers began to complain of feeling chilly. They started wearing sweaters and wraps to work in spite of the fact that thermostat records showed that the temperature in the room was just as high as it had been in previous years. The average room temperature had to be raised three or four degrees before the workers felt comfortable. The following summer, the office was redecorated in cream yellow and the trouble disappeared. Thus, a different color on the walls literally was equal to three or four degrees on the thermometer!

From Europe, early last summer, reports



Make a paper disk like the one below, but larger. Mount it on cardboard and put a pin through the center. Note the various color sensations produced by spinning it at different rates of speed





Color-wise design makes packages look larger and more attractive. In each case, new design is at left

reached the United States that fiendish "insanity cells" had been used to shatter the nerves of war prisoners in Spain. Captured soldiers were pushed into odd-shaped rooms with fantastic designs painted in jarring, brilliant colors on the walls. In addition, rays of harsh-colored lamps played incessantly over them during their confinement. A complete mental breakdown was the aim of this diabolical "design for insanity."

That color alone can produce profound changes in the mind is now widely recognized in medicine. The western hospital that induced a patient to quit a hunger strike by placing him in a red-walled room is but one of many institutions employing similar methods. One noted Swiss hospital, in fact, has a whole series of "rainbow solariums." Each of these sun rooms is inclosed in tinted glass, and each shade is employed in the treatment of a specific mental ill.

In some nervous disorders, psychiatrists report, gaudy color schemes seem to act as a stimulant to the systems of the patients. Hypersensitive, neurotic people, on the other hand, are soothed by blue. When you are nervous and overwrought, a calming color is spring green. And, when you are sleepless and troubled by headaches, anemone mauve or firmament blue is prescribed.

One young woman, subject to fits of recurring melancholy, finds relief by entering a room equipped with red lights as soon as the "blues" come on. She remains there until she feels the stimulation of the color. Then, in another room decorated with vivid tones of yellow and gold, she "tapers off" until her normal state of mind returns.

Of all the manifold uses of color

for producing mental states, the most dramatic is probably one reported from London, England. For years, the Whitechapel span over the Thames River was known as "suicide bridge." It was a favorite place for unfortunates to end their lives by leaping into the river below. In an effort to reduce the number of these fatal plunges, city officials ordered the bridge painted a soft and soothing shade of green. Almost as soon as the change in color scheme was carried out, suicides at the bridge began to decrease.

Another bit of color magic is a feature of many up-to-date hospitals. Waiting rooms are being decorated with calming, soothing hues. This lessens the strain for relatives waiting during an operation or at times when patients are passing through a crisis.

Thus the work of the modern color expert ranges all the way from tinting baseballs to make them more visible, to camouflaging war machines; from stepping up the sale of asbestos shingles, to curing maladies of the mind; from luring insects into electric traps, to imparting a holiday mood to visitors at



To help them in choosing colors that will sell goods, experts ask people in all walks of life to compare and select favorites

a summer resort. The province of these scientists is a rapidly expanding field of research. Discoveries already made have given us glimpses ahead, letting us visualize the manifold ways in which an increasing knowledge of color will affect our daily lives in

future years. They indicate that in the world of tomorrow color will not be merely an incidental adornment, but a powerful tool in the hands of the physician, the psychologist, and the industrial designer for making human life happier and more satisfying.

TEST YOUR PERSONALITY WITH COLORS

 Color engineers have discovered a close connection between a person's color preferences and his personality. For example, if you like yellow, you are probably the intellectual type, with a philosophy of your own and a hankering to reform others and convert them to your way of thinking. You have a keen mind but are handicapped by intolerance and lack of human sympathy

 Purple is the color of royalty—and although royalty is out of date, purple is still affected by persons with a tendency to be vain, selfish, and egotistical. They like to think themselves superior to others, though the opinion is not always shared by their intimates. However, a taste for purple may be accompanied by the more desirable royal quality of magnanimity

 If you like orange, you are what people call a "good fellow"—a lover of companionship and conviviality. Wine, women, and song are your dish. You like to talk and are good at it, though you are not sure to hold the same opinion for two days in a row. Unfortunately, your friendships are neither deep nor lasting. Likable personality and quick wit make you a good salesman

 Blue is the color of the conservative, self-controlled character. If you lean to this hue in your clothing and surroundings, you are likely to have sound judgment and a strong sense of duty. On the other hand, you may have a tendency to take yourself and your affairs a little too seriously. You could have a better time if you could only learn to let yourself go

 Is red your favorite color? Then you are probably impulsive, with strong desires and a liking for action and excitement. You may manage to conceal your emotions, but they are there just the same. Fickleness and a lack of perseverance are your greatest handicaps. Learn to manage and direct your strong passions, and they will give you the rich life that you crave

 People who prefer green are the happy average folks—good friends, good neighbors, good mixers. They like to belong to clubs and societies, read the new books, see the new movies and plays. They know the value of money, but they're willing to part with it for a good cause. Their liking for the "good things of life"—wealth, comfort, social position—is sincere

 Do you choose brown suits, brown shirts, brown ties? Then, the color experts say, you are substantial and common-sense. You prefer old-fashioned things, and have no use for fads. Though your own life is so well-regulated that some may call you "set in your ways," you have little interest in the affairs of the rest of humanity. You may be a little smug. And you like gravy



Motor and shaft impart vibration to the curler

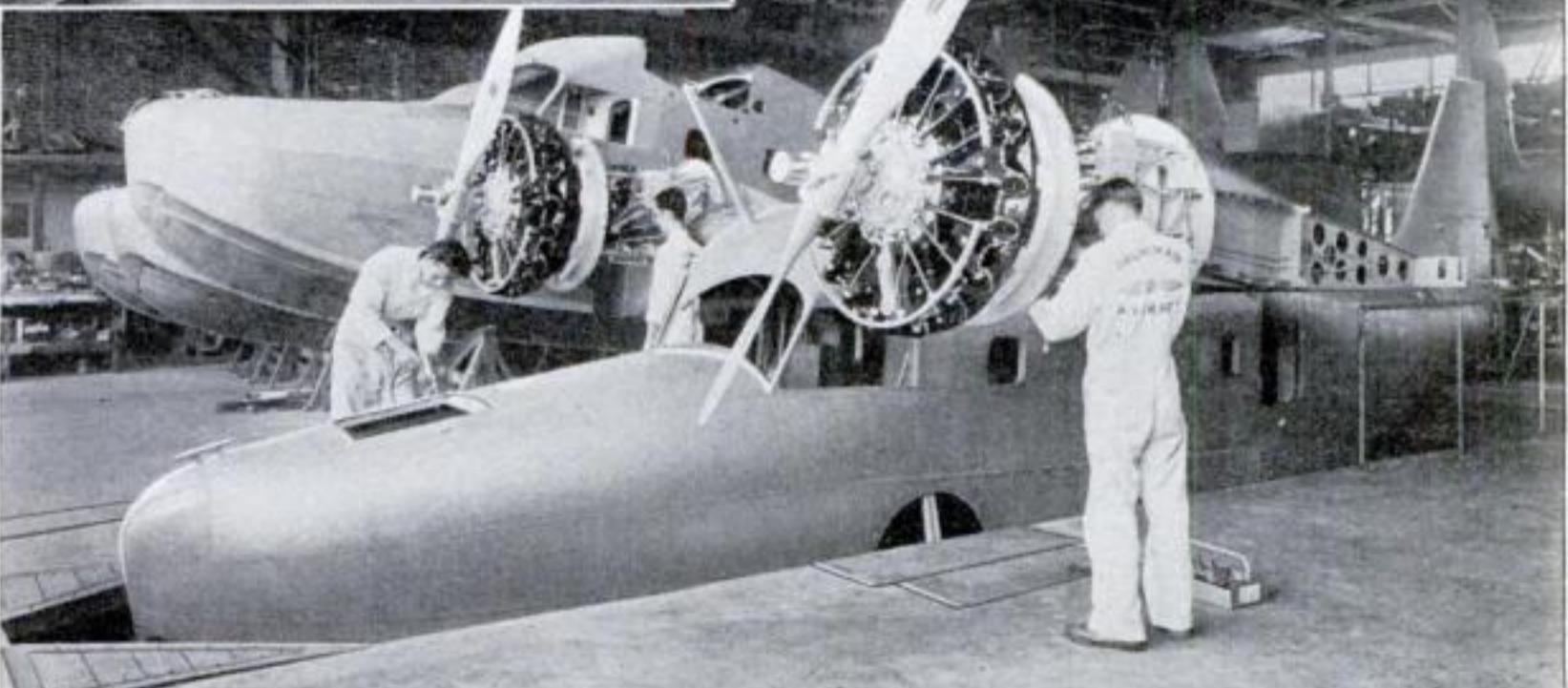
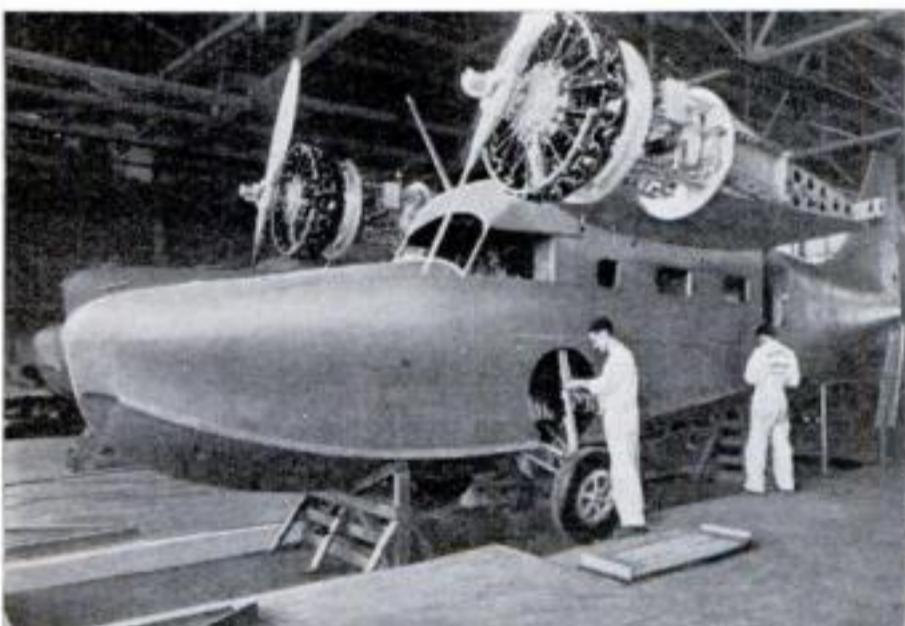
Vibrating Curling Iron Waves Any Kind of Hair

SUCCESSFUL results are said to be assured in curling dry, oily, straight, kinky, or practically any other type of hair, with a new waving machine just introduced. Powered by electricity, the device employs a vibrating curling iron that can be regulated to four different heats so that the proper temperature can be obtained for any type of hair. No lotions and no hair drier are needed in waving hair with the new machine.

Chemists May Make Rain

RAIN may someday be produced by chemical means in periods of drought, under a plan proposed by two Hungarian scientists. Gaseous, liquid, or solid fuels, placed in containers on the soil or on the surface of lakes, would be ignited by electricity, causing rapidly rising masses of hot air that would result in showers of rain.

Elevator Racks Speed Up Plane Building

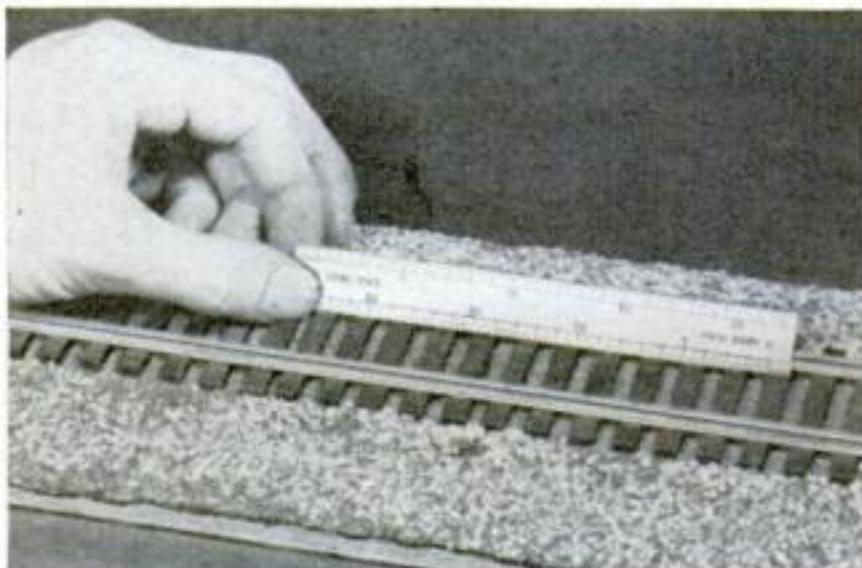


Two views of an amphibian on the assembly line. The lift raises and lowers the plane as required

LADDERS, scaffolding, and other rigging are not necessary for assembling planes in a Long Island aircraft factory which has installed novel new elevator racks in its production line. Mechanics stand at floor level to work on a plane, using the lift to raise or lower the ship to the most convenient height. Forty feet long and six feet wide, the elevator platform can also be tipped endwise.



Private Leslie Bland with outfit used in making night color photos



Measuring crosstie placement with new O-gauge rule

Odd Ventilator Pumps Pure Air to Bomb Cellar

KNOWING that poison gas seldom rises more than thirty feet above ground level, a British inventor worked out an odd device designed to draw fresh air into gasproof shelters on or under the ground. Resembling a giant accordion, a special hand-operated bellows sucks fresh air into the shelter through a flue pipe that extends up forty feet above the ground. Said to be foolproof, the apparatus draws in air at the rate of 400 cubic feet a minute.



This apparatus sucks uncontaminated air from above the thirty-foot level

Color Pictures of Flying Plane Made at Night

To MAKE color photographs at night of a plane in flight, Private Leslie Bland, U. S. Army photographer at Randolph Field, Tex., used the odd lighting set-up pictured at the left. Flying in an accompanying plane, Bland arranged a cluster of four photoflash bulbs and reflectors around his camera to provide adequate illumination for the night shot. The four bulbs were synchronized so that they all were set off at the same instant.

Model-Railroad Builders Get Handy O-Gauge Rule

MADE of stainless steel, a handy rule for model-railroad builders who work in O gauge is now available. One edge of the rule is marked in scale feet on the usual O-gauge scale of a quarter inch to one foot, while the other edge shows scale feet on the alternative O-gauge scale of seventeen sixtieths of an inch to one foot. Decimal equivalents for number-size drills are listed on the reverse side of the rule.



ICE-BOAT PILOT RIDES INSIDE THE SAIL

ENTERING through a small door in the side, J. L. Finch, of Patchogue, N. Y., drives his curious ice boat, pictured above, from within a fixed, fabric-covered airfoil that serves as a sail for the craft. Instead of controlling his ice racer by manipulating a sail,

Finch turns the forward movable runners on which the boat rides to get it into the most advantageous position in the prevailing wind. Windows are built into the leading edge of the airplane-wing sail. Finch calls his strange craft an "ice glider."

Odd Jobs for Your Phonograph



Wooing slumber with a phonograph. Carefully chosen words, recorded in a soothing voice, soon put the hearer to sleep

WHAT will put you to sleep, wake you up, improve your hearing, and teach you card tricks, foreign languages, or duck calls? Simple enough—your phonograph. New disks make it a jack-of-all-trades to serve your need or fancy.

An innovation for curing insomnia is a twelve-inch record, recently placed on the market. Start it going and you will hear a soft, soothing voice telling you how to relax your muscles and free your mind of cares. Selected words and phrases, whose power of suggestion has been proved by experiment, are said to make you drowsy and finally lull you into deep, restful slumber. According to the psychologist who made the recording, a leading broadcasting company considered adopting his idea as a regular bedtime radio feature, but turned it down because of the danger that motorists with car radios would fall asleep at the wheel!

Is your problem that of getting up in the morning? A Brown University sophomore has found one solution. At seven-thirty, his radio-phonograph automatically plays a recording of his own voice. Coaxingly at first,



then more sternly, it urges him to arise. It tells him what deans do to students who miss early classes. Finally it bawls the command, "GET UP!" Thus admonished, the owner of the voice leaps out of bed (he says).

What would you like to learn? If it's how to be a duck caller, a new kit provides a handmade duck call and a phonograph record explaining how to use it. A similar set makes you a Pied Piper for crows.

On another phonograph record, a card-trick expert has recorded complete directions for performing six of his most mystifying stunts. Practice following his lead, with a pack of cards in your hand, and

If you want to learn to call ducks, you can get a handmade call and a record that tells how to use it. The picture below shows the kit in use



A phonograph gets this college student up for early classes. Set off by an alarm clock, it plays a recording of a stern lecture on oversleeping, in the student's own voice



Card tricks are another subject taught by records. With the cards in his hands, the user follows instructions recorded by an expert. Three double-faced disks present full directions for six mystifying stunts



you'll soon be the life of almost any party.

In case your ambition is to parlay-voo in some foreign language, you will have no trouble getting recorded lessons in almost

any tongue you choose. And a boon for people inclined toward deafness, just announced, is a special record giving successive tones of different pitch for exercises in hearing.



Metal Life Preserver Holds Food and Water

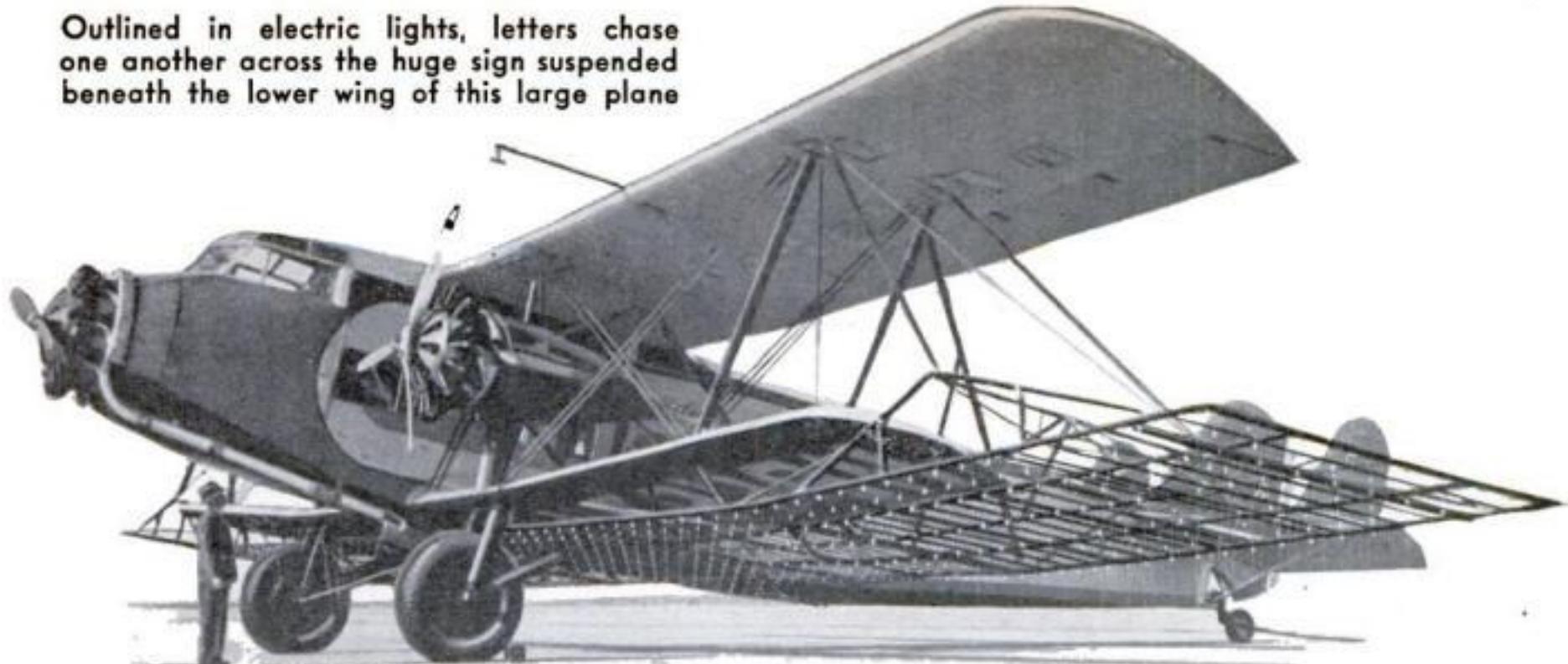


The new all-metal life preserver is seen above being tested in a pool

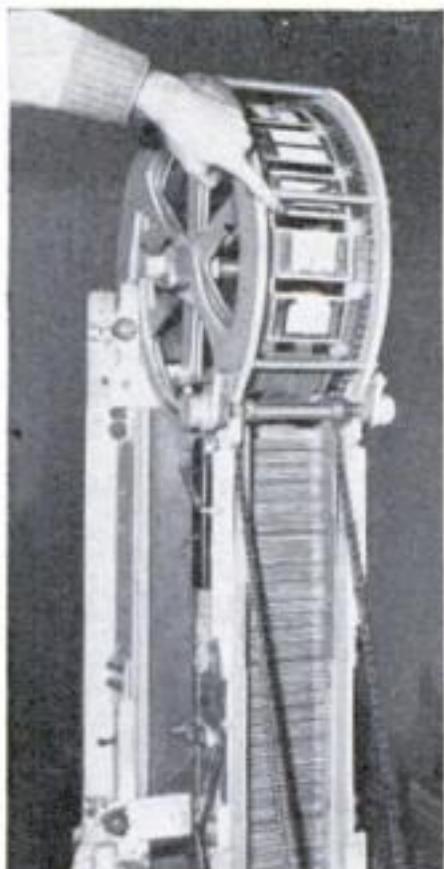
Water-tight compartments house food and water, and materials to use in signaling by night and day

MADE entirely of metal, a life preserver capable of keeping six persons afloat indefinitely has been offered recently for use in the British Navy. Water-tight compartments built into the device are stocked with emergency rations and fresh drinking water to sustain the persons supported by it until help arrives. In addition, the life-saving unit is equipped with automatic smoke signals for use by daylight, and with flares that can be spotted a mile or more away at night, to guide rescuers.

Outlined in electric lights, letters chase one another across the huge sign suspended beneath the lower wing of this large plane



This is the motor that drives the 4,500-watt generator which supplies power for the sign. At right is the intricate light-control mechanism

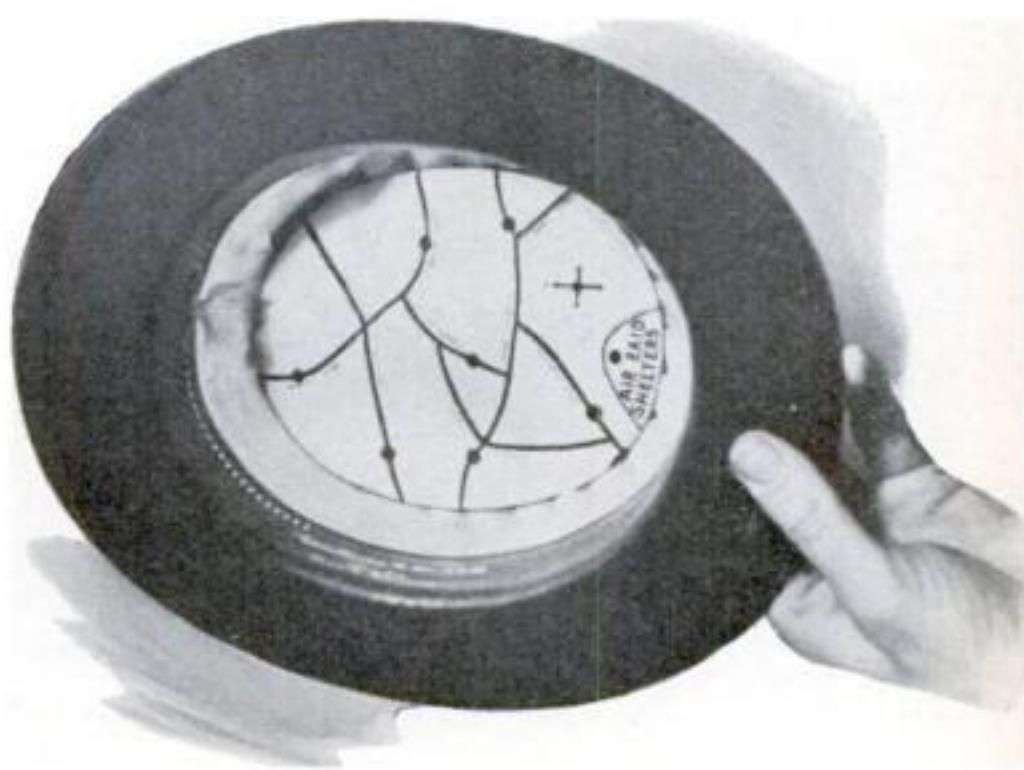


Giant Electric Sign Is Carried by Plane

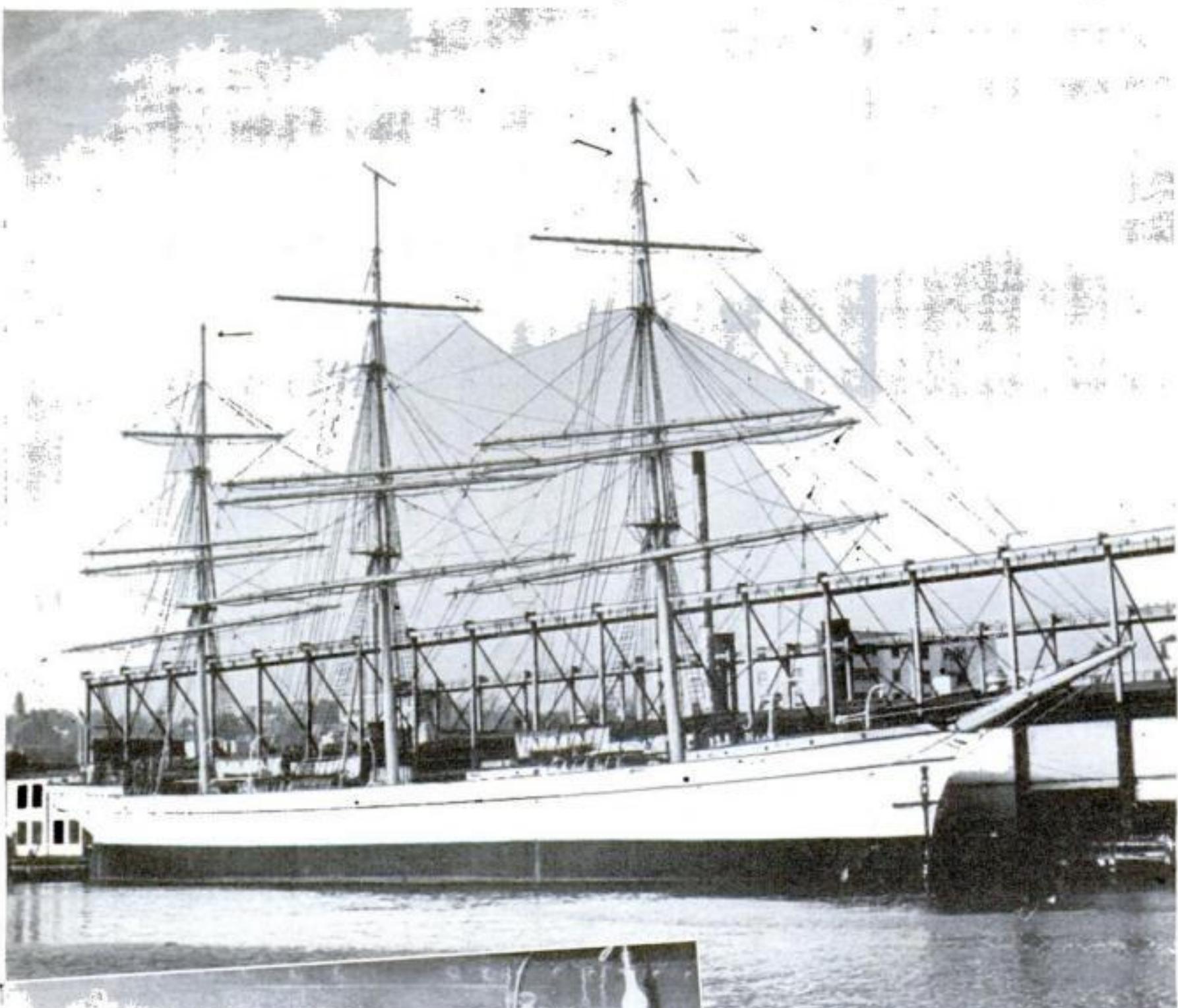
CALLED the largest of its kind in the world, a flying electric advertising sign is suspended beneath the lower wing of a large transport plane. Designed to be read at an altitude of 3,000 feet, the sign is of the "traveling" type—complete sentences travel across its face in moving letters as lights are switched on and off by means of an intricate control mechanism installed within the plane fuselage. A motor-driven, 4,500-watt generator supplies the necessary electric current to light the 1,000 lamps of the flying billboard.

Keeps Air-Raid Map Under His Hat

ALTHOUGH not quite so good as a steel helmet, the black derby hat owned by an Englishman living on the east coast is a handy headpiece to have along in the event of an enemy air raid. For inside of his bowler, this Britisher has pasted a map on which the location of local air-raid shelters is plainly marked. When an air-raid alarm sounds, he has merely to doff his bombing bonnet and look inside it to find the location of the nearest underground hide-out.



Sailors Refit Old Square-Rigged Ship



The "Tusitala," veteran square-rigger, being made ready to sail again. At left, sailors at work calking the seams of a lifeboat

square-rigged merchant ship. Rescued from the waterfront yards of a New England scrap dealer, the graceful vessel was tied up at Staten Island, New York City, where more than 100 seamen are now putting the square-rigger back into shape. The *Tusitala* has not put out to sea in over seven years, although, decades ago, she plied a regular run to Hawaii in the molasses trade. In addition to a thorough overhauling of hull and rigging, the sailor

workmen are installing a 'tween-decks machine shop, and replacing sand ballast with 12,000 115-pound concrete blocks. In May, the old-timer is expected to sail for Miami, Fla., to be used as a training ship.

FORCED from their regular jobs by the curtailment of foreign shipping, a group of American merchant seamen are now hard at work remodeling and refitting the *Tusitala*, the only surviving American



Bulletless Rifle Practice Improves Aim

NO BULLETS or powder are needed for an odd type of rifle practice demonstrated by British soldiers in the photograph above. A sergeant, seen at the right, holds a tiny tar-

get in front of one eye, and looks through a peep hole in the center to check the soldier's aim by seeing that his gun sights line up with the bull's-eye.

Mechanical Calculator Aids Plane Designers

WORKING from data gained in extensive wind-tunnel tests with model airplanes, Lewis L. Imm, California inventor, has developed an automatic computing machine that should simplify the calculating chores of airplane designers, operators, and pilots. Merely by twisting dials on the panel of the instrument, engineers make the machine perform the work of correlating weight, speed, rate of climb, altitude, and other factors. In another use, military aviation experts employ the automatic calculator to enable ground crews to load bombing planes most effectively.



Lewis L. Imm with his calculator for airplane design



Woman Invents Process for Curing Tobacco

SPEEDY curing of tobacco is said to be accomplished by a new process worked out by a Cleveland, Ohio, chemist, Jacqueline S. Front. Although details of the new treatment have not been revealed, it is reported that cigar tobacco can be completely cured in the space of a few hours, instead of the weeks and sometimes months required by present methods. The inventor is shown at work in her laboratory.

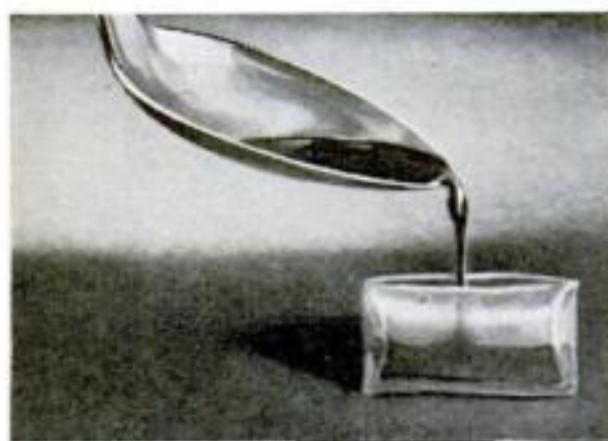


Periscope Is Built into Dugout

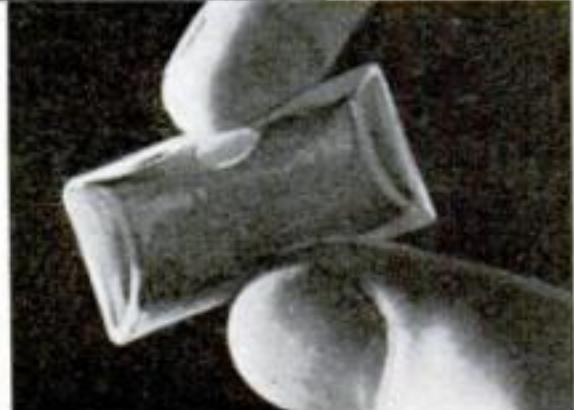
TAKEN "somewhere in France," the photograph above shows a soldier attached to a Scots regiment on watch in an underground concrete shelter. Using a built-in periscope, the sentry can scan the area on all sides of the sunken dugout, and obtain a clear view of any advance of the enemy without exposing himself to the fire of snipers or enemy patrols.

Freckleproof Cape Protects Bather

FAIR Floridians who fear freckles have adopted the odd hooded cape pictured in the photograph below, taken at an Atlantic beach resort. Made of a polka-dot print fabric, the freckleproof cape has an attached hood equipped with built-in sun glasses to further protect the wearer from the effects of strong sunlight.



A teaspoonful of cough syrup is sealed inside the candy shell. Note the bubble in the drop at right

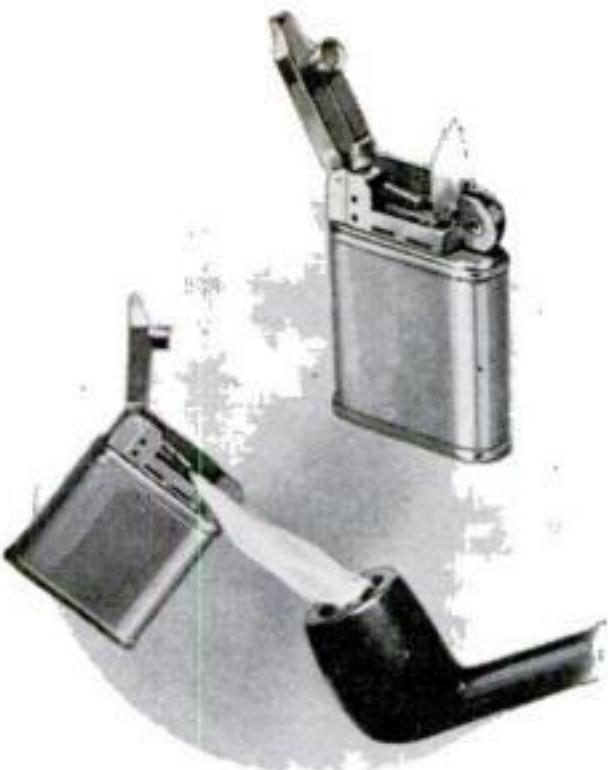


Cough Drop Has Liquid Center

COUGH DROPS that have liquid cough medicine in their centers are now on the market. In manufacturing the remedy, a teaspoonful of a cough syrup is placed within a hollow candy shell, and the open edge of the latter is sealed. The shell dissolves in the mouth of the user, releasing the cough syrup.

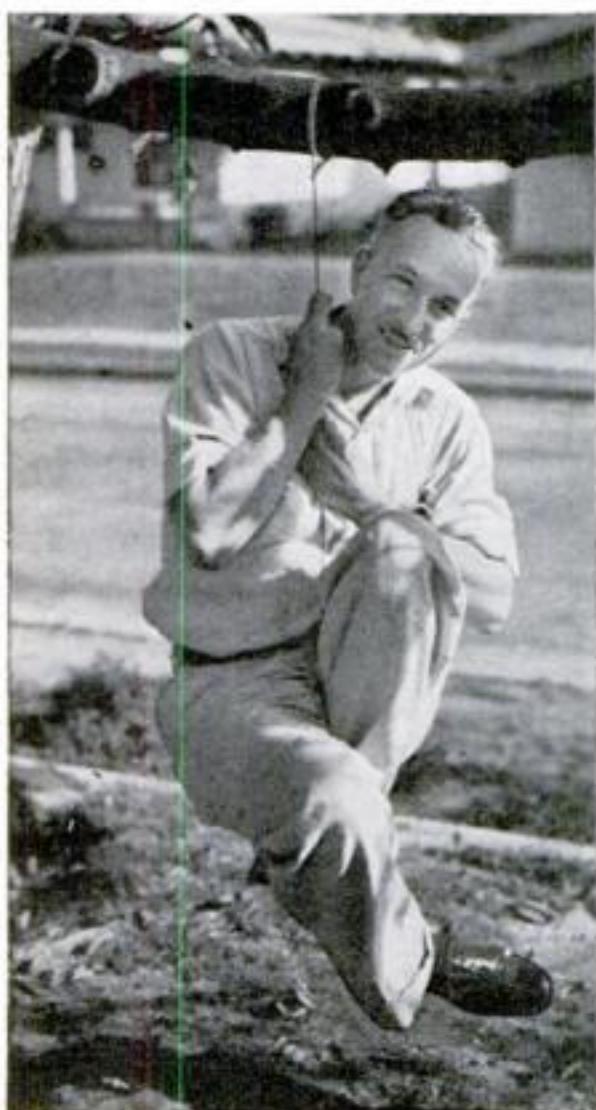
Ants Keep Homes Cozy by Air-Conditioning

ANT HILLS are kept at comfortable temperatures by air-conditioning crews which open and close ventilating passages at morning and night, according to Mutsuo Katō, of Tokyo, Japan. Eighty to eighty-four degrees F. is the ants' idea of comfort.



Pipe Smokers Get Lighters

DESIGNED especially for pipe smokers, a new mechanical lighter now on the market throws a jet of flame directly into the bowl of a pipe, as shown in the illustration above. A standard wheel, flint, and wick assembly produces a flame as in conventional lighters. But when the accessory is tipped sidewise, the flame contacts a tiny copper tube, causing an expansion of gas that blows the flame to one side.



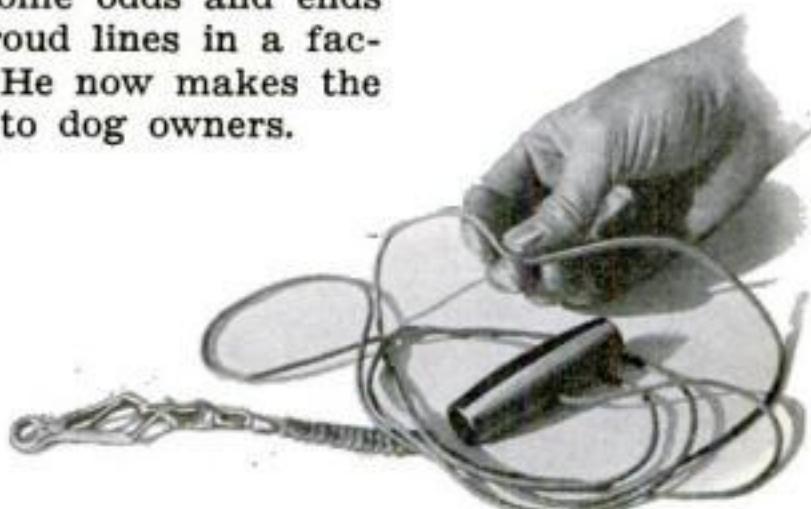
Gas Bag on Roof Holds Bus Fuel

MOUNTED on the roof tops of English busses, balloonlike fabric bags are serving as reservoirs for coal gas, a fuel now in general use as a substitute for gasoline. In the photograph reproduced above, coal gas is being piped into the roof-top balloon reservoir of a bus before the vehicle starts off on a scheduled run.

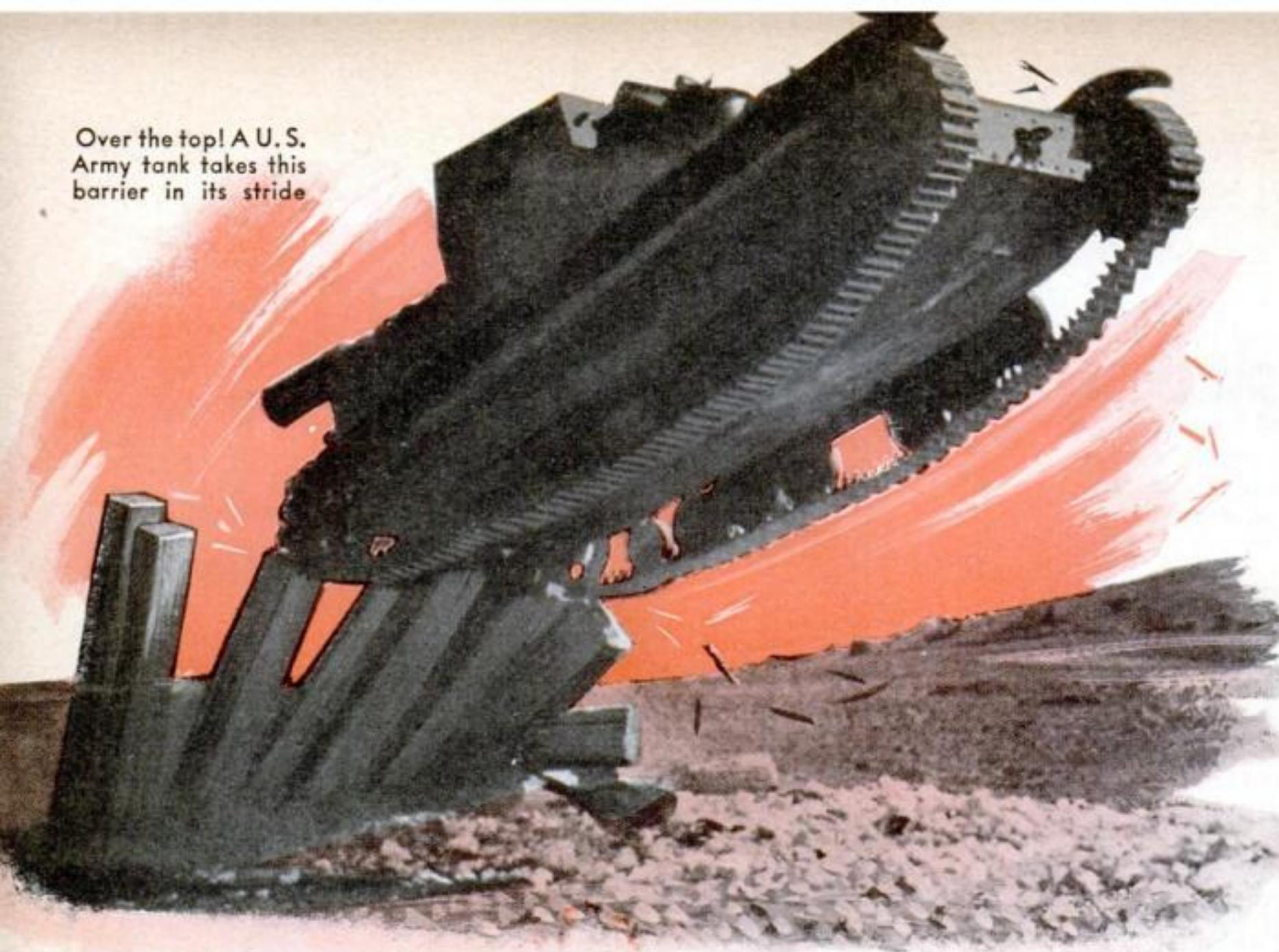
Dog Leash from Parachute Cord

ABOUT the diameter of a shoe string, a dog leash made of silk of the type employed for parachute shroud lines weighs less than two ounces but is said to be strong enough to tether a horse. The idea for the lightweight leash occurred to Vernon D. Smith, a jobless Californian, when, on visiting a Burbank parachute factory, he found some odds and ends of parachute shroud lines in a factory trash box. He now makes the leashes for sale to dog owners.

Here's proof of the strength of a lightweight dog leash of parachute - shroud material. The leash is shown at the right



Over the top! A U.S. Army tank takes this barrier in its stride



UNCLE SAM grooms his *HELL BUGGIES*

A CLOSE-UP VIEW OF OUR
HARD-HITTING TANK FORCE

ONE cold morning this winter I stood in a big, open field at Fort Hoyle, Md., talking about tanks with Lieut.-Col. B. G. Chynoweth, who commands the First Battalion of the 66th Infantry, the Regular Army light-tank regiment which traces its history back to the American Tank Brigades which fought in Belgium and in the Argonne two decades ago. Near us a long line of tanks stood waiting; 600 yards away, where scrub and brown underbrush edged the field, men were working over a bullet-scarred, paintless old Renault which, crewless, was serving as a moving target for its offspring.

"Take a ride in one of the tanks," the Colonel invited. "That's the best way to get an idea of what they're like."

When I lowered myself through the turret port—a tanker needs to be a fair sort of acrobat—into the right-hand front seat, the

sergeant who was driving gave me a friendly grin. The inside of a tank with its engine running isn't the best place in the world for verbal amenities. There wasn't any room to spare, but the steel walls were painted white, and with the driving and turret ports open the interior was light.

The sergeant manipulated one of his steering levers after the other and nudged his eleven-ton steed around sharply. We began to move forward, picking up speed quickly. The motion over the fairly rough field was noticeable but not unpleasant—a sort of easy pitching, like the motion of a small boat when a ground swell is running. I thought that we were going about twenty-five miles an hour, but later was told that we had been doing a good thirty-five. When

By ARTHUR GRAHAME

we reached the end of the field the sergeant swept his tank around in a wide turn. Then we roared back up the field, turned sharply, and nosed into our berth at one end of the firing line as neatly as a sport roadster could have done it.

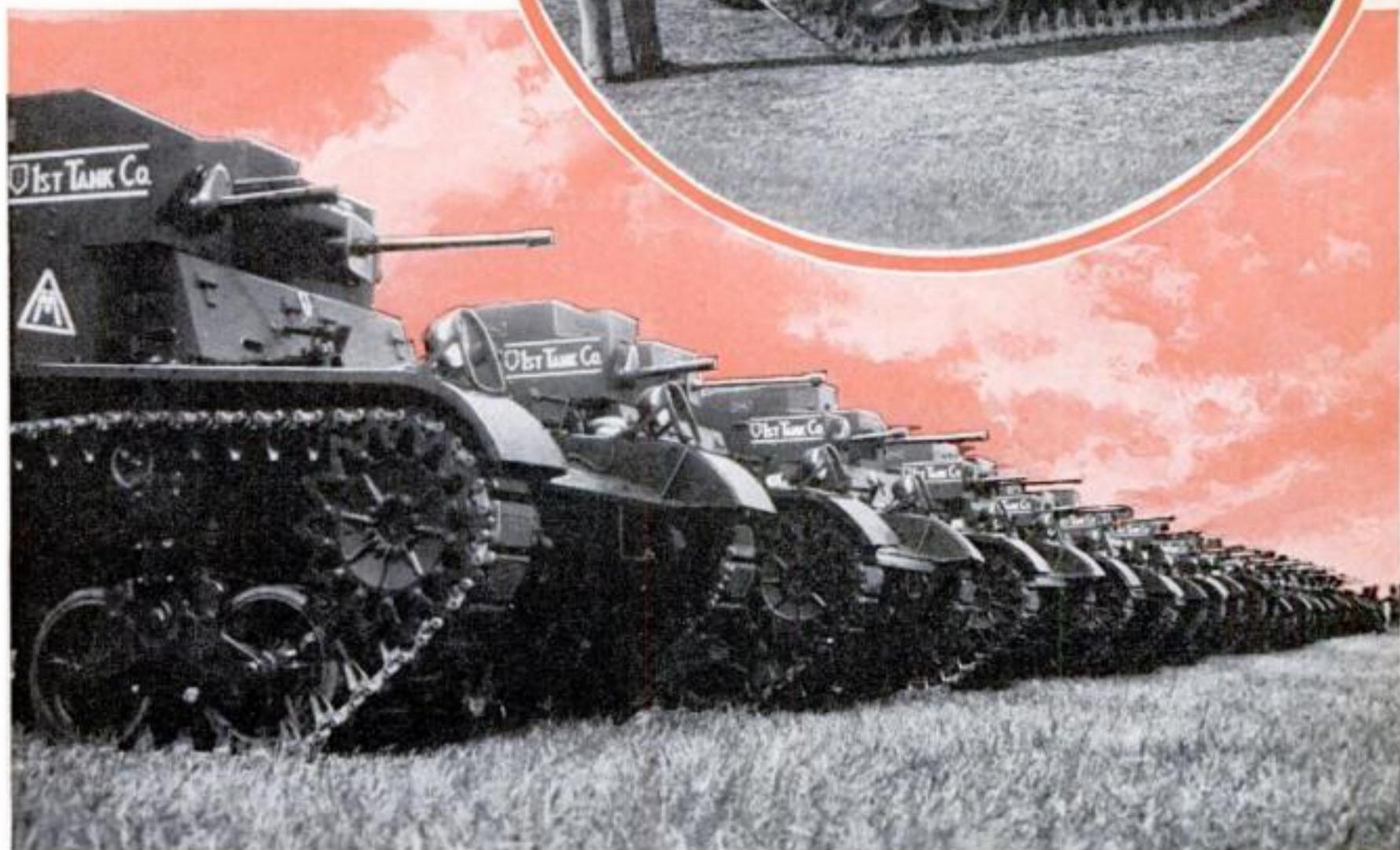
Of course, riding in a tank over an open field isn't anything like riding in a tank over the sort of terrain on which tank battles are likely to be fought—rough ground made rougher by being well cut up with trenches and shell holes and by being strewn thickly with obstructions of various unpleasant kinds. And the interior of a tank with its ports open isn't anything like the inside of a full-crewed tank with its ports closed for action—which, men who know from experience told me, can be very hot when bullets are spanging on its steel sides. Tankers are trained and hardened to "take it" over the roughest ground under simulated battle conditions.

Colonel Chynoweth asked me if I'd like to try a few bursts at the old Renault, which had been headed so that it would run across the field in front of the lined-up

Tankers groom their steel charger. Below is a line-up of the "hell buggies" on which Uncle Sam relies

tanks. I moved back to the rear seat, which is somewhat higher than the front seat, and one of the officers showed me how to wedge myself in behind the .30 caliber turret machine gun. You fold your right leg under you and kneel on the seat, brace your left foot solidly against the steel floor plate, and press your back hard against the back of the turret. That settles you as solid as a rock, bringing your shoulder snugly against the gun butt and your right eye close to the sight tube alongside the barrel. Horizontal and vertical hair lines divide the sight's eyepiece into four quadrants, and the gun is mounted so that only slight pressure is needed to change its elevation or to traverse its muzzle across a wide field of fire.

While I was getting acquainted with my



gun, the sergeant had switched off his engine and was getting set to do a little shooting with the .50 caliber machine gun in the other turret. "Get the nose of the tank in the upper right quadrant and you'll sock her," he advised. Looking through the narrow eye slit above the gun I saw that the old Renault had been started and was rumbling briskly across the field. It seemed a lot smaller than it had a minute earlier. When I squinted through the sight the tank looked even smaller. At 600 yards it blended into the drab scrub behind it, and smoke from underbrush which had been set afire by tracer bullets on an earlier run didn't make the target any clearer.

I got the tank's nose in the upper right quadrant, and pressed the trigger. The gun went *tat-tat-tat*, and the fiery tracer bullets told me that I was shooting high and to the right. I swung the muzzle down and to the left—and couldn't find the tank! All I could see through the sight was a vague cloud of brown dust kicked up by bullets from the twenty-odd machine guns which were firing. I aimed at the dust cloud, but I don't think I hit anything in it.

When I had fired all my shots I watched through the eye slit. Near the end of its run the tank came clear of the dust cloud

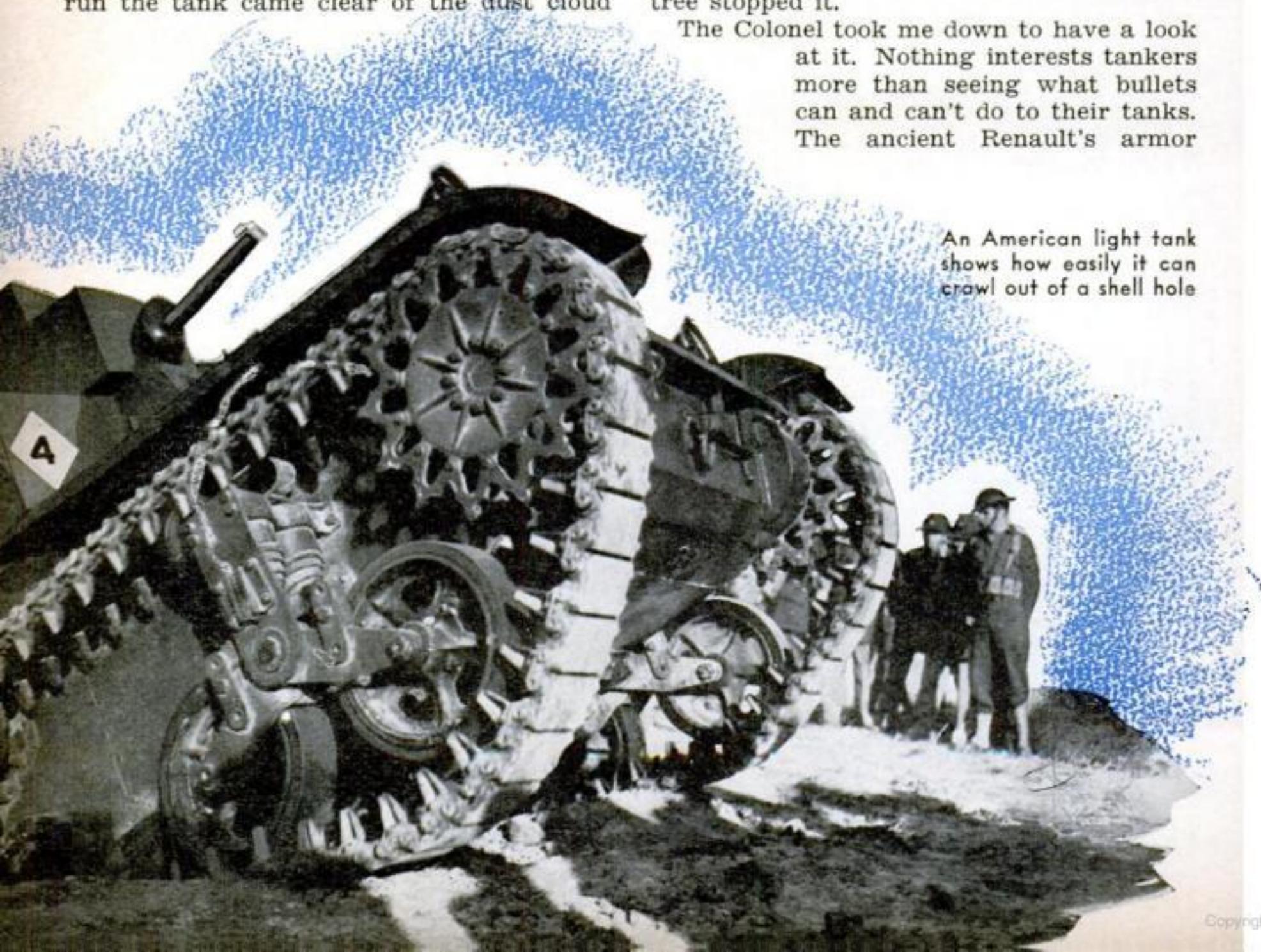
Time to leave her! Crew members practice what

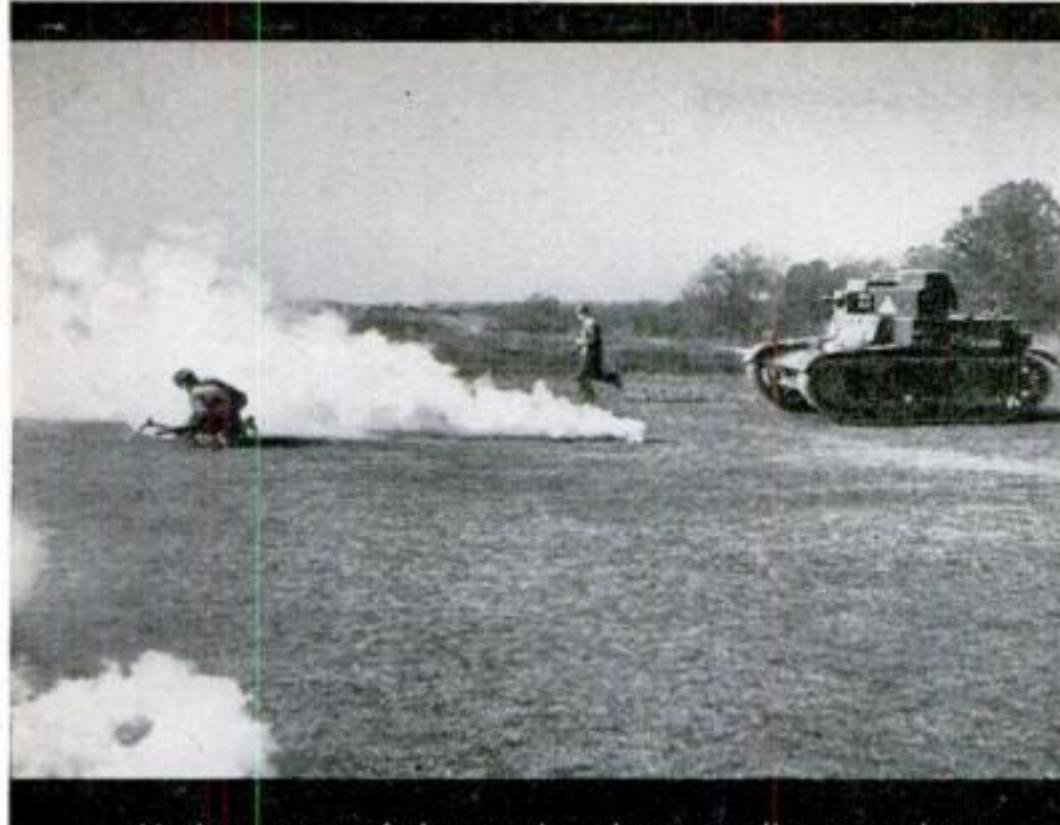
they are supposed to do if their tank is disabled in action. First, a smoke screen is laid

and some gunner got squarely on his target. You could see the tracer bullets bouncing off its armor into the tree tops, like red balls out of a Roman candle. The cease-firing whistles sounded, but that old Renault kept right on going. The long wire, connected with its engine switch, which it had been trailing behind had been cut by a bullet. The tank crashed into the underbrush and wallowed slowly along until a fair-sized tree stopped it.

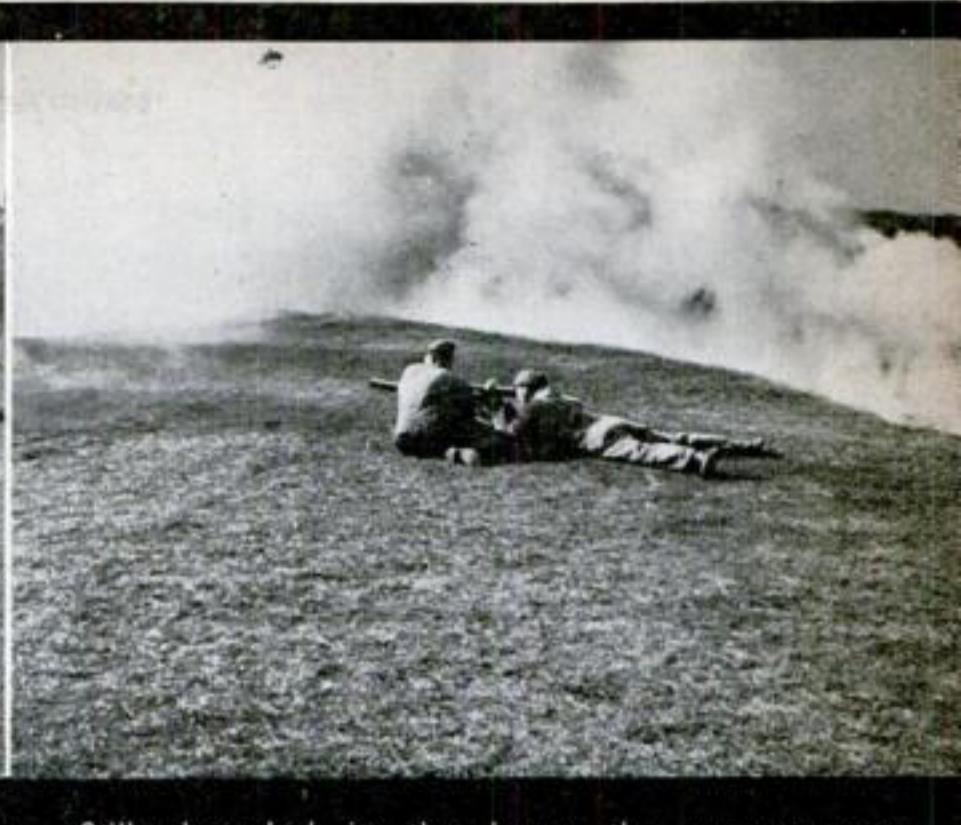
The Colonel took me down to have a look at it. Nothing interests tankers more than seeing what bullets can and can't do to their tanks. The ancient Renault's armor

An American light tank shows how easily it can crawl out of a shell hole





Under cover of the smoke, the men dismount the machine guns and mount them on the ground with tripods that are carried on the forward deck



Still shrouded in the haze, the gunners are ready to defend their tank from capture in the event of a counterattack by the enemy infantry

was scratched and dented by several hundred machine-gun bullets, but not one of them had gone through it.

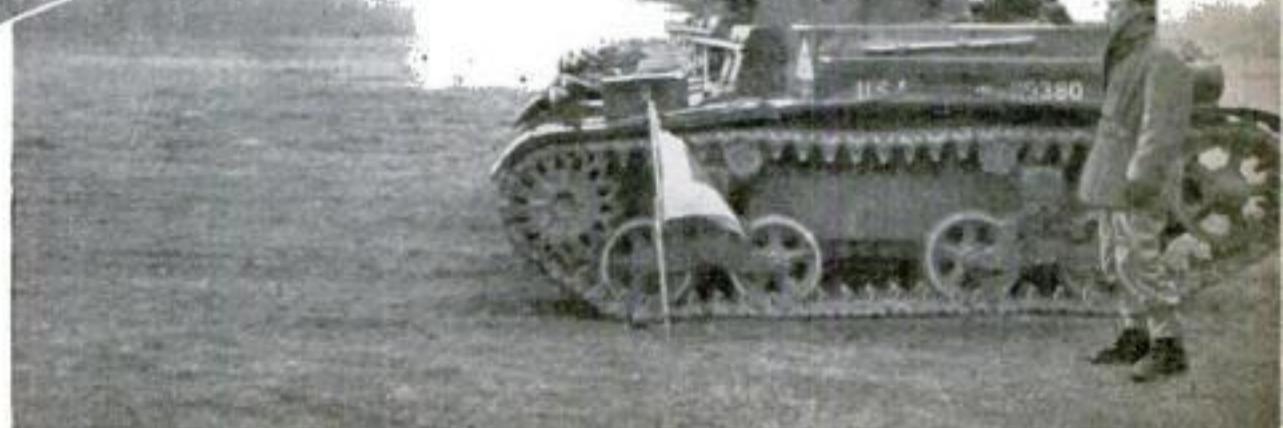
My close-up of tanks at work taught me three important things about them: that they can move fast, that they aren't easy to hit, and that if their armor is moderately heavy they aren't very likely to be hurt by machine-gun or rifle fire.

While the U. S. Army can't compare with European mechanized forces in number of tanks, American officers are confident that we are away ahead of them in quality—that in the M2A4 model tank now being built we have the best light tank in the world. Driven by a powerful airplane-type, air-cooled engine, it has a road speed of above thirty-five miles an hour and a correspondingly high cross-country speed. Its armor is heavier and its tracks longer than the present standard light tank, and in addition to four machine guns it carries a 37-millimeter cannon. The tracks, driven by sprockets and rolling over four bogie wheels on each side which support the weight of the vehicle, are made of a long-wearing, heat-resisting rubber composition set in steel blocks. Its engine, transmission, drive, and tracks all are considered superior to those of any foreign tank.

The medium tank now being built *(Continued on page 231)*



Crewless, this old Renault is driven past the firing line of new tanks at right, which pepper it with bullets



There's Music in the Air for Airplane Travelers



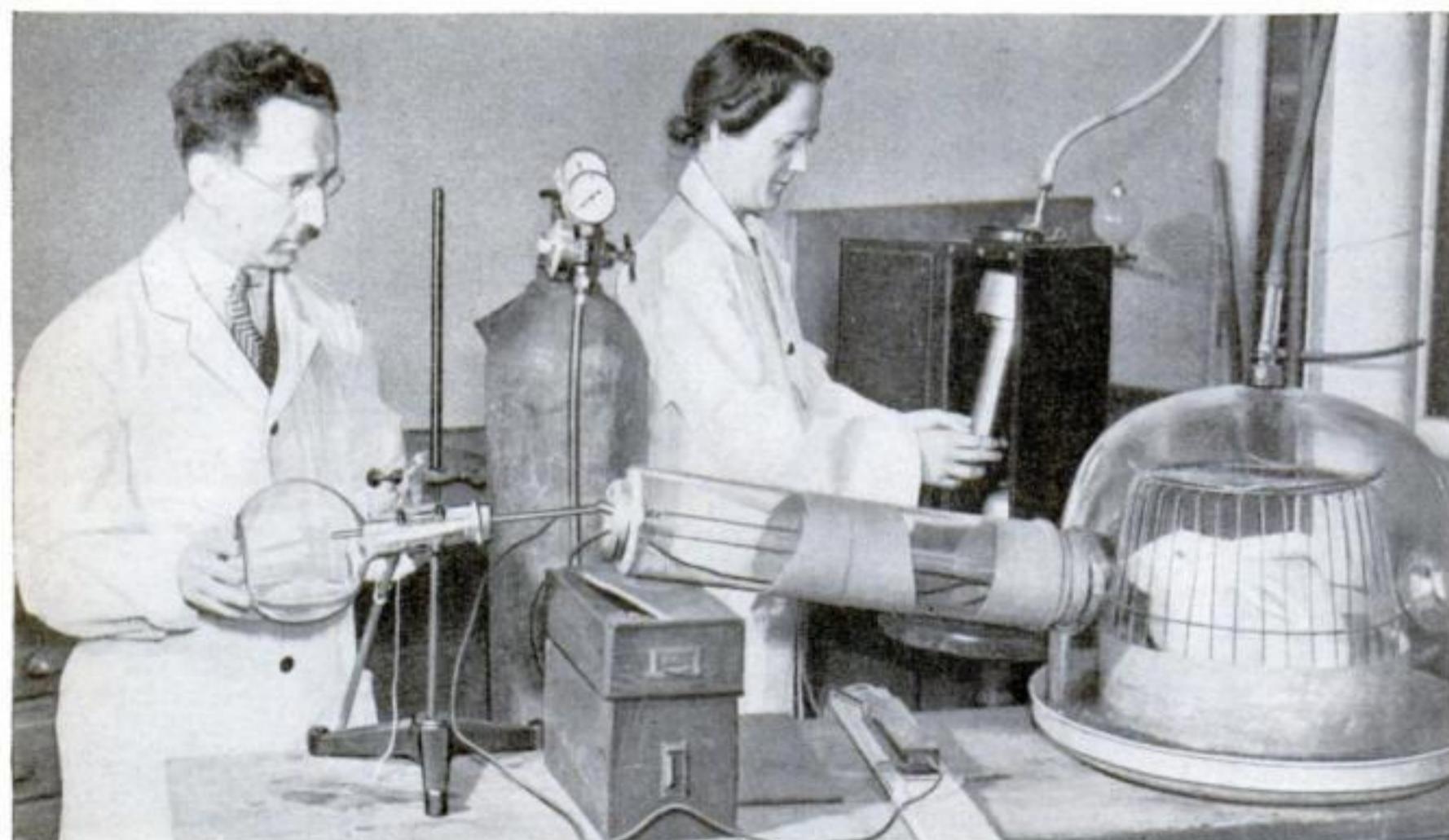
Air-line hostess tuning in a radio program.
Left, passenger with individual loudspeaker

AS THEY fly to their destinations, passengers on planes of a major transcontinental air line can now listen to broadcast radio programs. Stations are tuned in on a master set and the programs are piped to individual loudspeakers housed in padded units that hang over the seat backs of those passengers who desire to listen in.

Kachoo! Now It's a Mechanical Sneezer

INFECTIOUS germs are spouted from the mouth of a mechanical sneezer developed for medical research by William F. Wells of the University of Pennsylvania medical school in Philadelphia. By means of com-

pressed air, the apparatus blows air-borne germs through a tube into a glass bell housing an experimental rabbit, to simulate the common method of transmission of germs by human sneezers and coughers.



Dr. Max B. Lurie using machine-made coughs and sneezes to study the spread of infectious diseases

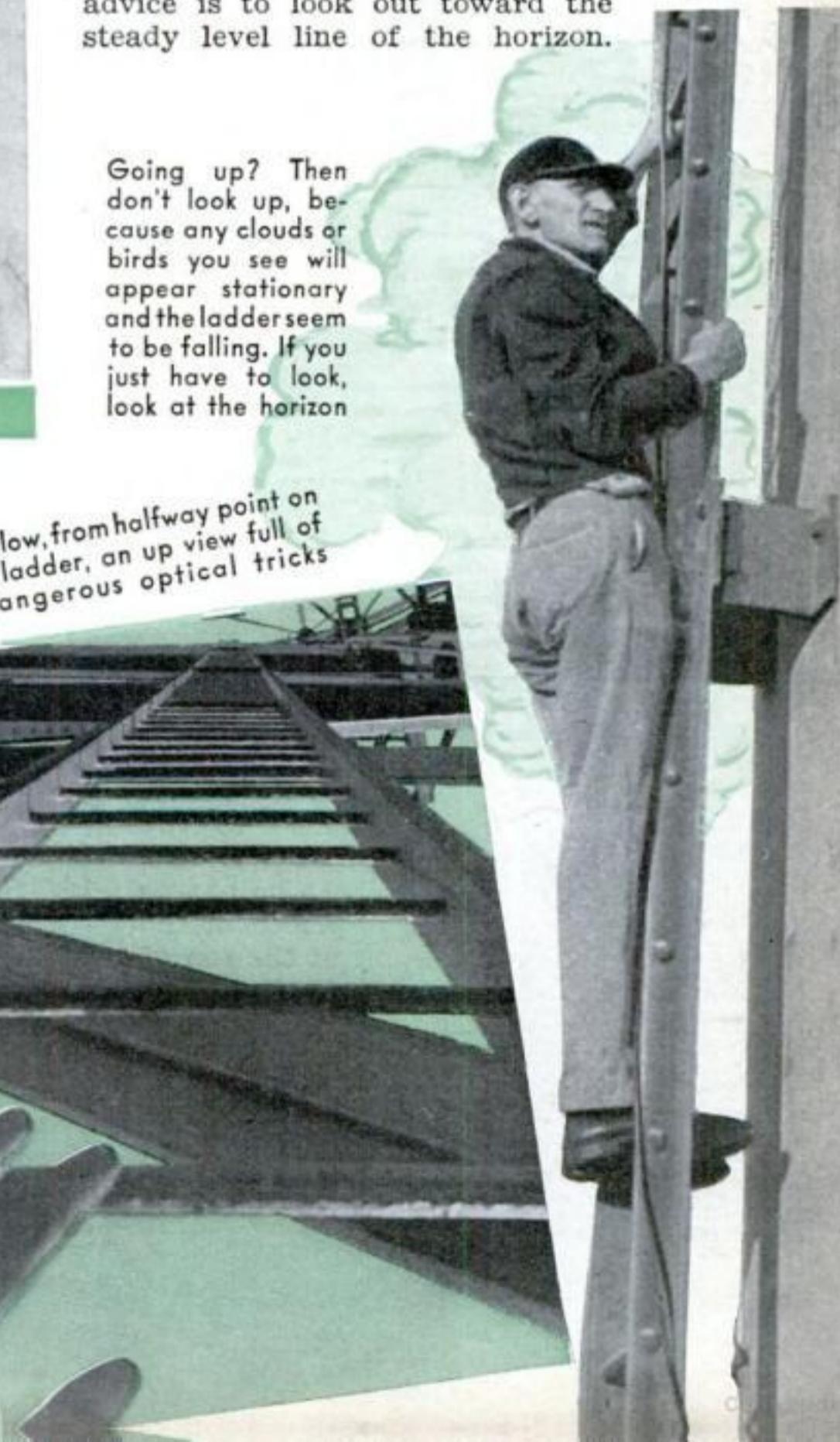
WHEN YOU CLIMB... Don't Look Up!

YOUR muscles flutter, your brain reels, you lose control of your nerve—and you are in grave danger of a fatal fall. That's what can happen when you climb tall structures and violate the two simple rules that steeple jacks, steel workers, painters, and other professional climbers use to prevent the hazards of dizziness. First, don't lock down, and second, don't look up. Most people know that looking down from great heights can cause dizziness, but professionals say their second rule is even more important. For your upward view of moving clouds, smoke, or even birds may cause the optical illusion that they are stationary and that the ladder you're on is toppling over sidewise like a falling tree. If while climbing you feel that you must look somewhere, their advice is to look out toward the steady level line of the horizon.

Going up? Then don't look up, because any clouds or birds you see will appear stationary and the ladder seem to be falling. If you just have to look, look at the horizon

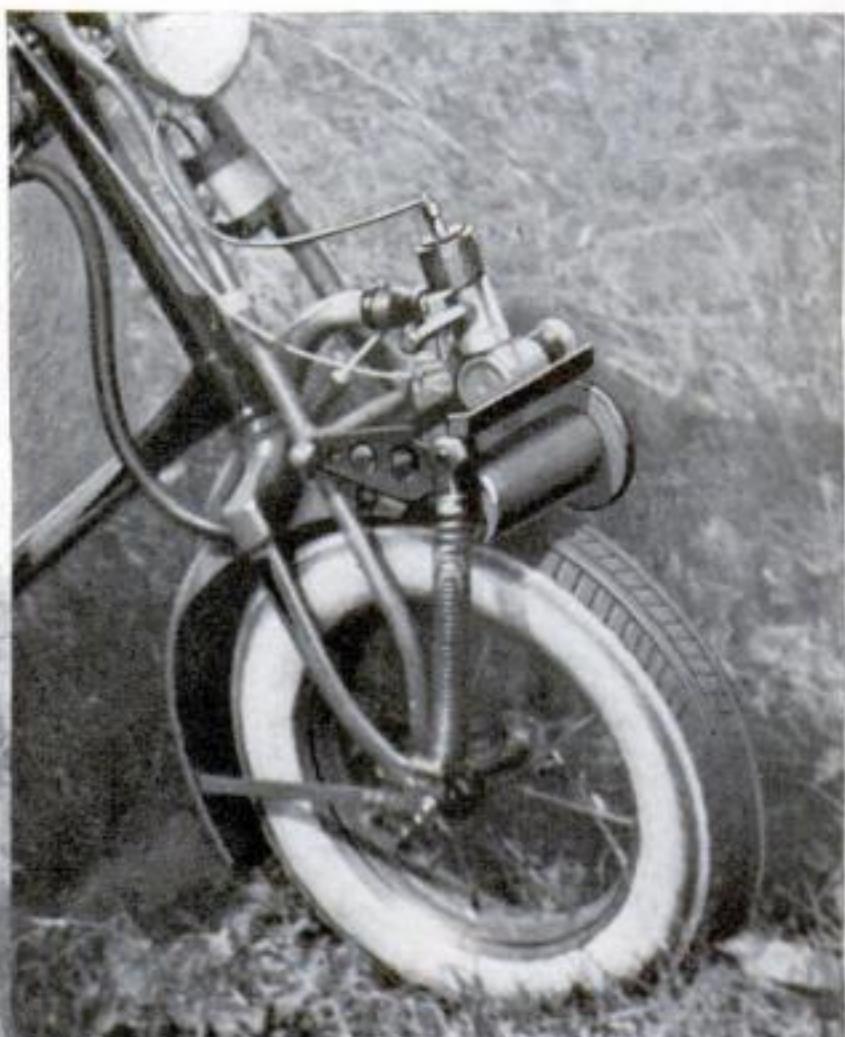
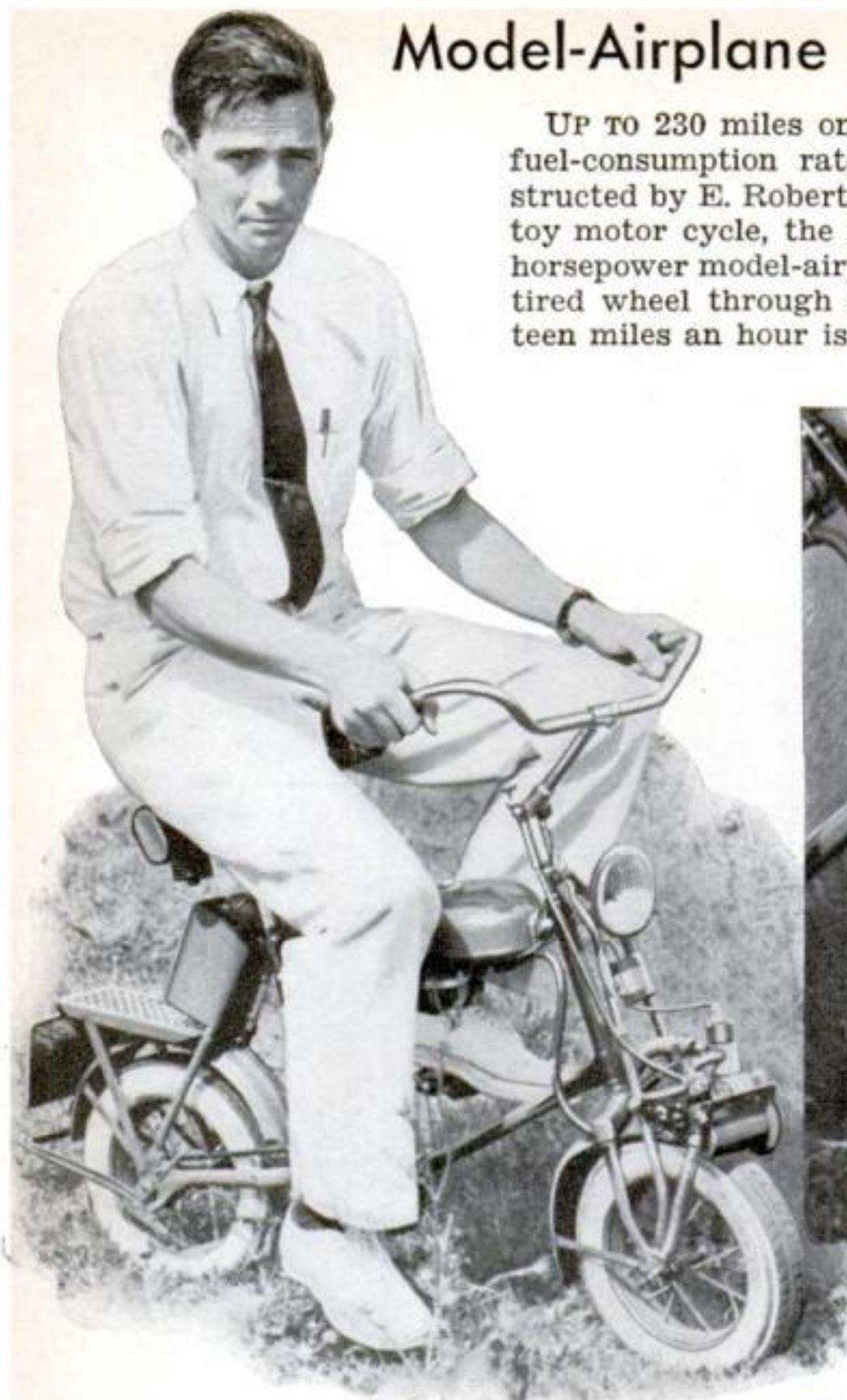
Below, from halfway point on a ladder, an up view full of dangerous optical tricks

Only 100 feet up, but it seems like miles to the climber who glances down those deadly converging lines



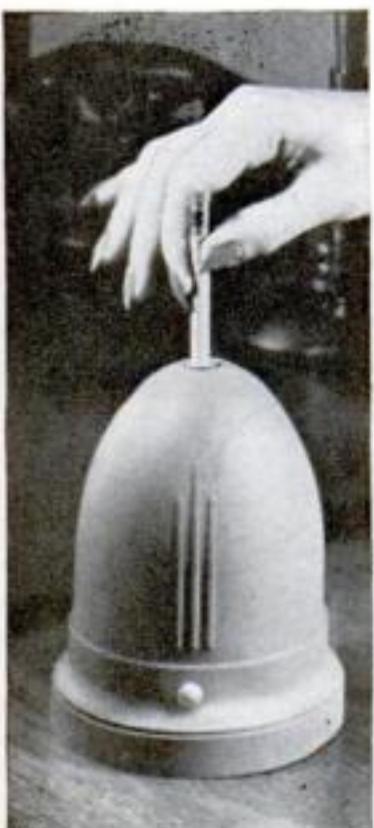
Model-Airplane Motor Drives Scooter

UP TO 230 miles on a gallon of gasoline is the economical fuel-consumption rate of a curious motorized scooter constructed by E. Roberts, of Philadelphia, Pa. Converted from a toy motor cycle, the midget vehicle is driven by a one-fifth-horsepower model-airplane engine, acting on the front rubber-tired wheel through a spring-supported friction roller. Fifteen miles an hour is top speed on level ground.

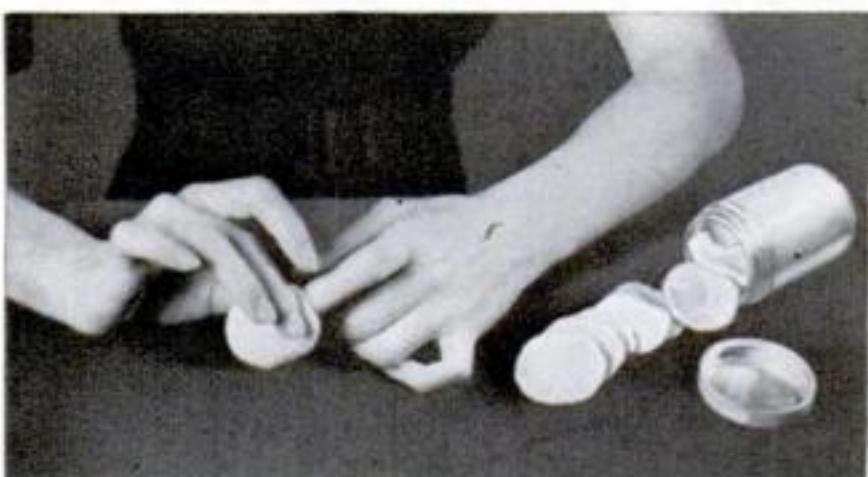


Connected to the front wheel by a friction roller, this tiny motor drives the scooter at left up to 230 miles on a gallon of gas

Novel Pencil Sharpener Runs by Electricity



DESIGNED as an improvement on the familiar hand-cranked desk model, a new pencil sharpener is operated by electricity. As pictured in the photograph at the left, a pencil to be sharpened is placed in the opening at the top of the unit's dustproof, dome-shaped housing. A small switch button is pressed, and within a few seconds the electrically powered mechanism forms a sharp writing point.



Pads Remove Nail Polish

MANICURE pads for removing old nail polish have been recently placed on the market. Made of absorbent material, the soft pads are impregnated with a special chemical solvent. When the pad is rubbed over the nail, the solution softens the old polish, which can then be easily wiped off with the absorbent pad itself. The pads also contain a medication for the nails.



A Coast Guard officer puts a big amphibian through its paces at Floyd Bennett Field. Here it is simulating a "carrier landing" on a cramped runway from various angles

How the U. S. Coast Guard Tries Out a New Plane

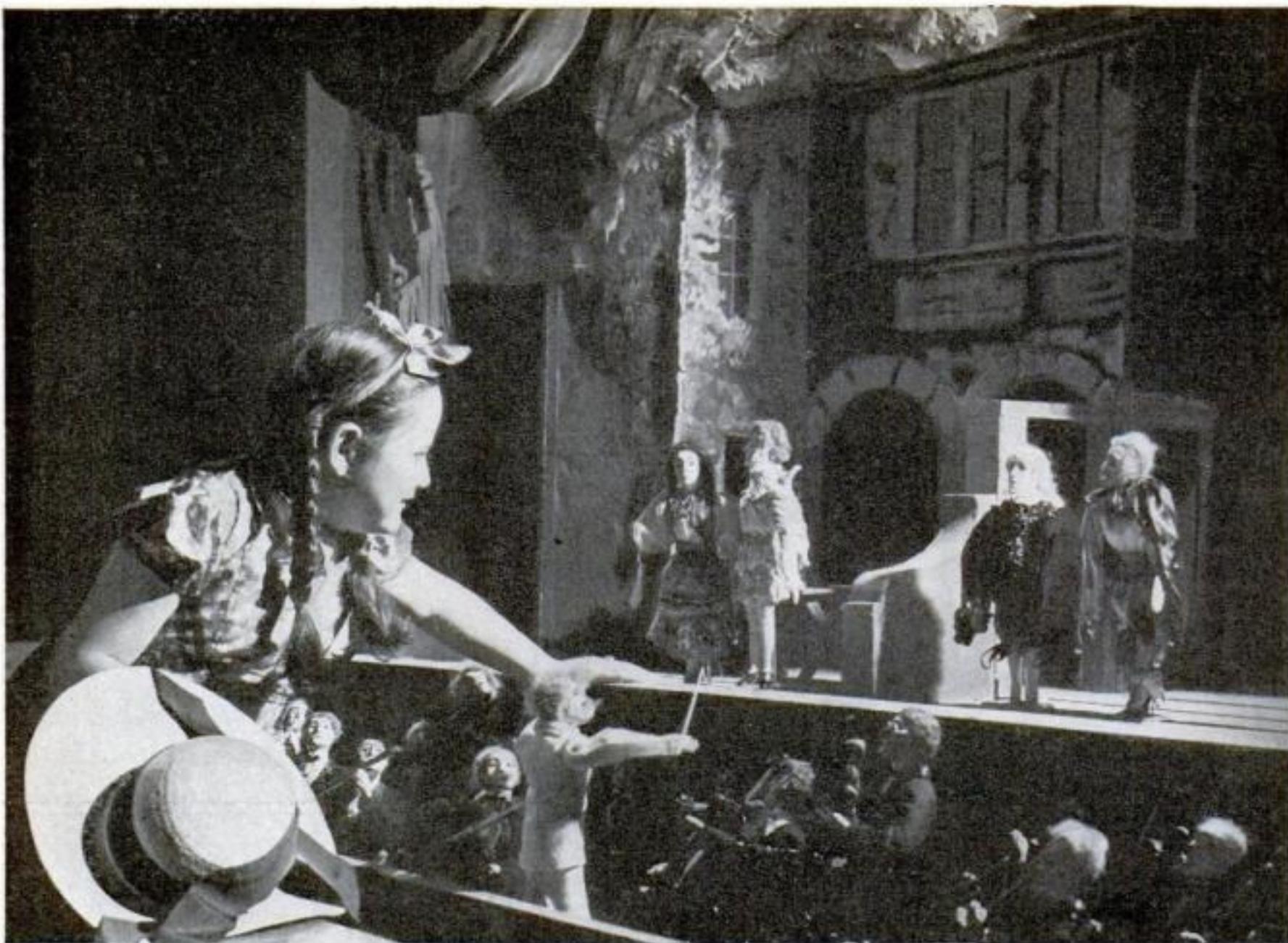
HANDLING in rough weather, maneuverability, fuel consumption, take-off and landing areas required, and maximum speed are among the many tests that U. S. Coast Guard experts give new airplanes before accepting them for service. In these photographs, taken at Floyd Bennett Field, New York City, Coast Guard technicians are shown putting a twin-motored amphibian through its paces before acceptance. Military thoroughness marks every step of the exhaustive trials.



For absolute accuracy in speed tests, regular instruments are supplemented by a pitot "bomb," which is trailed out of the cabin door with a fifty-foot cable, as seen in the upper picture

Fuel consumption is gauged by draining out every ounce of gasoline left in the plane's tanks at the end of the test flight, and measuring it carefully in a quart container





A young music lover enjoying Ernest Wolff's presentation of "Rigoletto." Note the puppet orchestra

BOY'S HOBBY CREATES

Puppet Opera



THIRTEEN years ago, in a Chicago basement, a twelve-year-old schoolboy, Ernest Wolff, began experimenting with puppets synchronized with opera recordings. His stage was an old apple crate, draped with cloth from his mother's sewing box; his illumination, a string of lights from the Christmas tree; his puppets, ordinary dolls.

Until that time, young Ernest had been just a typical

Wolff shows Helen Jepson, noted opera star, a puppet wearing a reproduction of one of Miss Jepson's own costumes

American boy, with a boy's disdain for anything that smacked of "high art." However, a visit to an opera in Europe gave him a strange jolt. The presentation was "Carmen." He was thrilled not only with the music, but with the elaborate lighting and staging. When he got back to Chicago he went to every performance of "Carmen" he could manage to see, getting in some way when he couldn't raise the money to pay.

Opera soon began to saturate his living. In his spare time he studied the lives of composers and artists, hummed tunes, made sketches of scenery and costumes he had seen at the Chicago Civic Opera. It was his ambition to devise a means to bring some of the thrill of grand opera to his friends, and to other music lovers who could not afford to attend a real performance by living singers.

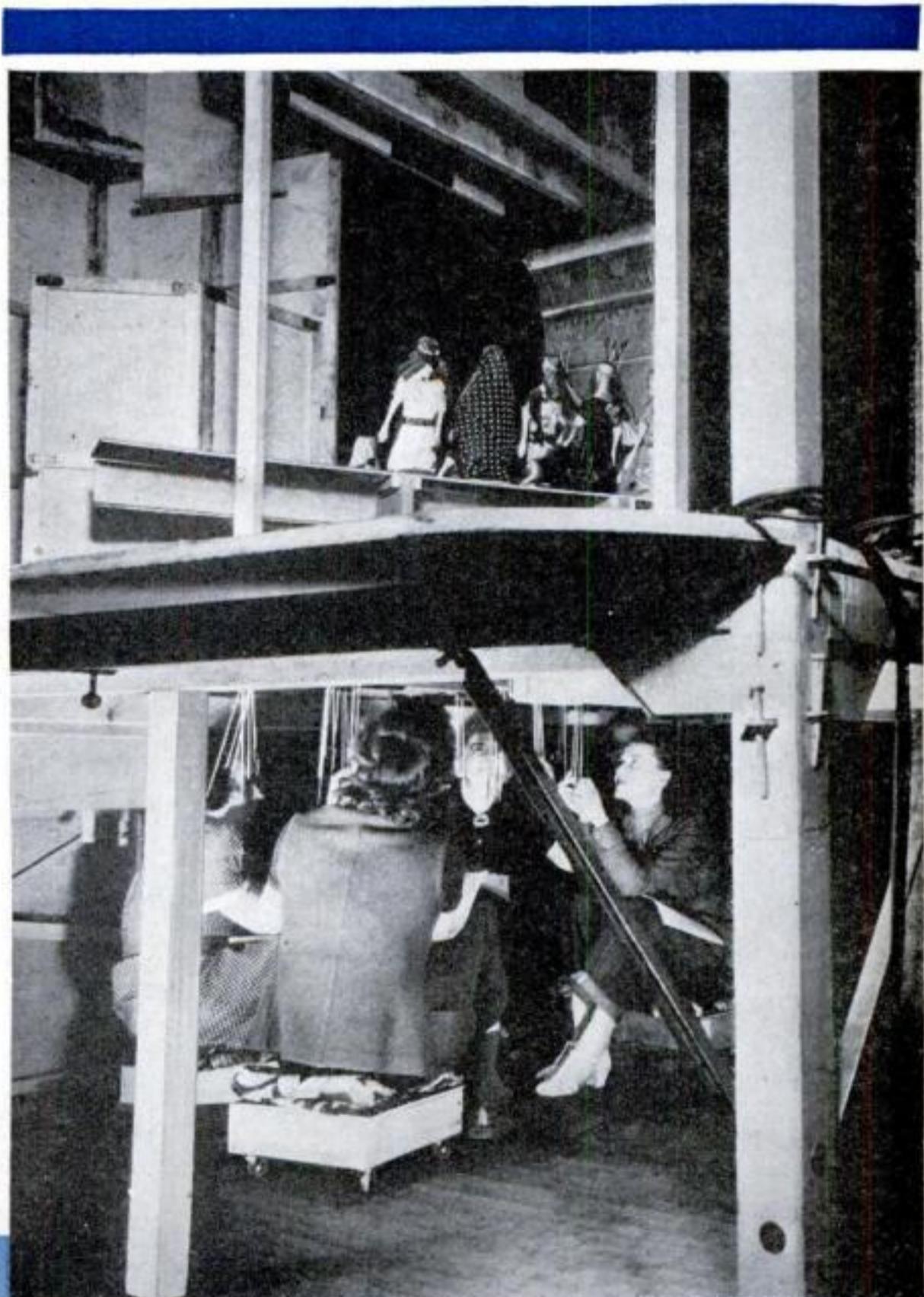
The apple-box stage, with its crude scenery, puppets, and lighting, was the beginning. At first, just a few friends were invited to witness the performances. Soon, however, the news spread, and neighbors and friends were flocking down into his basement "opera house" in such numbers that he had to charge a small admission fee to hold back the crowds!

With these fees, and every other cent he could save, Ernest Wolff kept building and rebuilding his miniature operas, aiming each time to come nearer the smooth perfection of a real opera. Finally outgrowing his basement auditorium, he built a portable outfit and gave performances before women's clubs and

music societies throughout Chicago. Today, the twenty-five-year-old impresario is showing his miniature operas before music lovers in cities from New York to San Francisco, with no let-up in sight for future engagements.

Designed entirely by Wolff, and built largely by him and his company of assistants, the present opera equipment is a triumph of miniature stagecraft. Believing that the frivolousness of the average puppet show is out of place in a serious opera, he has striven for realism throughout.

The cast consists of nearly 200 thirteen-inch puppet opera stars, with a wardrobe of 300 hand-sewn miniature costumes, each authentic in every detail. To produce this huge cast, Wolff first modeled two standard heads in clay—one of a man, and the other a woman. From these models, wooden heads were



By
**ARTHUR A.
STUART**

Sliding about on "dolies" under the floor of the miniature stage, puppeteers operate the tiny figures by means of rods and wires. The dolls move along slots in the floor



A puppeteer displays the mechanism of one of the "characters." At the right are some of the 300 costumes designed and made by Wolff's mother. Many of them were patterned after the costumes used in famous European and American opera companies. The picture at top of page shows how it looks to an audience

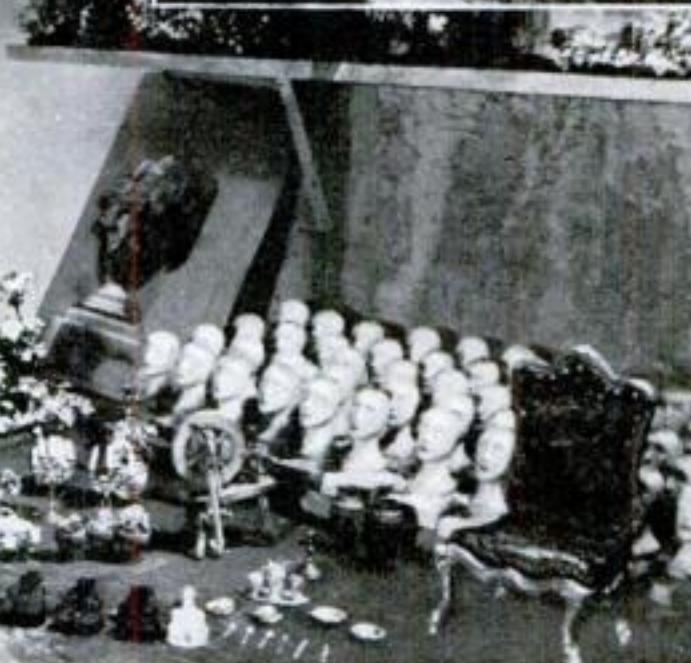
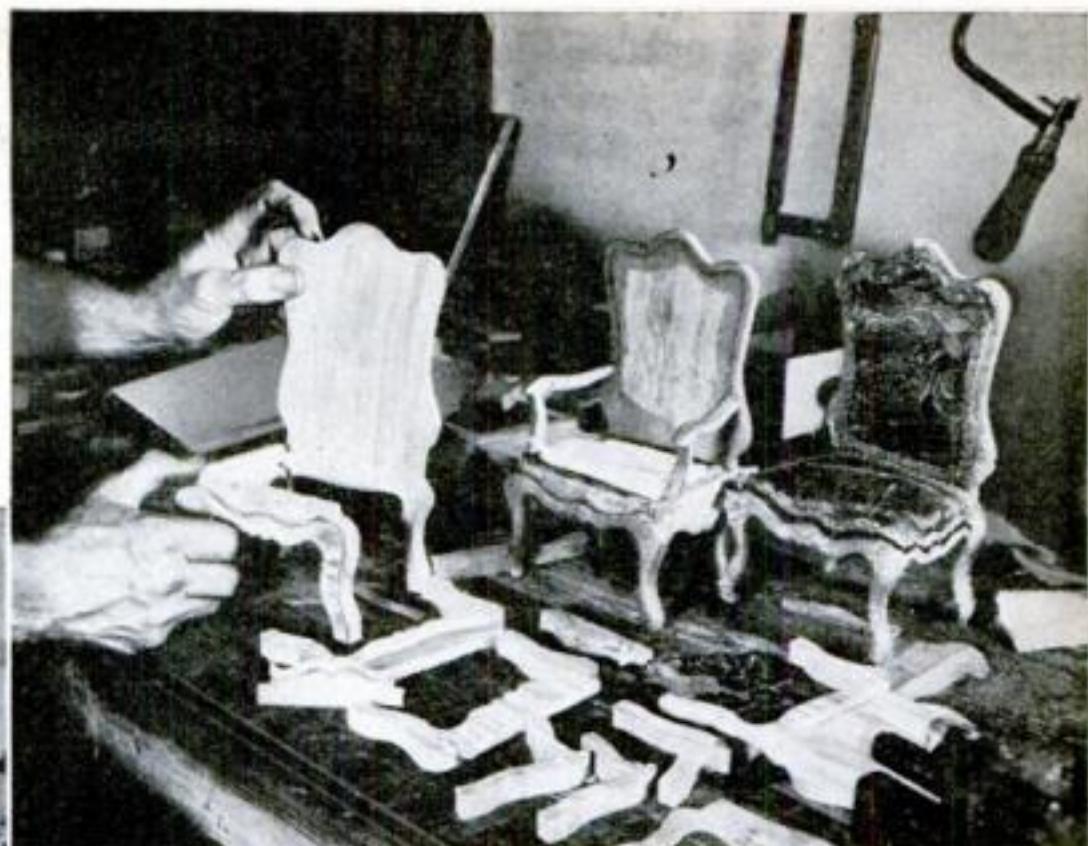
turned out wholesale on a carving machine. The wooden heads were then given individual character by appropriate painting and wigs. Bodies were made for the puppets by means of wire and padding.

To permit the amazing scenic and lighting effects of a real opera production, ordinary marionettes worked by strings were out of the question. Stringed puppets could not go through gates and doorways; an overhead puppeteers' loft would interfere with lights and scenery. A mechanism therefore had to be devised whereby the puppets could be operated realistically from beneath the stage. The problem was finally solved by having stiff wires, extending down through the body, work the arms and head, the puppets



Miniature period furniture being built and upholstered for "La Traviata." Most of the tiny stage "props" were made by hand

Wolff at work on artificial greenery to decorate a setting. Every piece of equipment is realistic. In the background are puppet heads



Below, the make-up artist at work. "Blank" heads of wood are given individual characteristics through wigs and painted facial features



moving about along paths formed by a series of slots cut in the stage.

The stage properties, most of which were made by hand, include three complete suits of period furniture, spinning wheels, tables, chairs, fireplaces, vases, candlesticks, silverware, jewel boxes, couches, lanterns, chandeliers, donkey carts, and many other pieces.

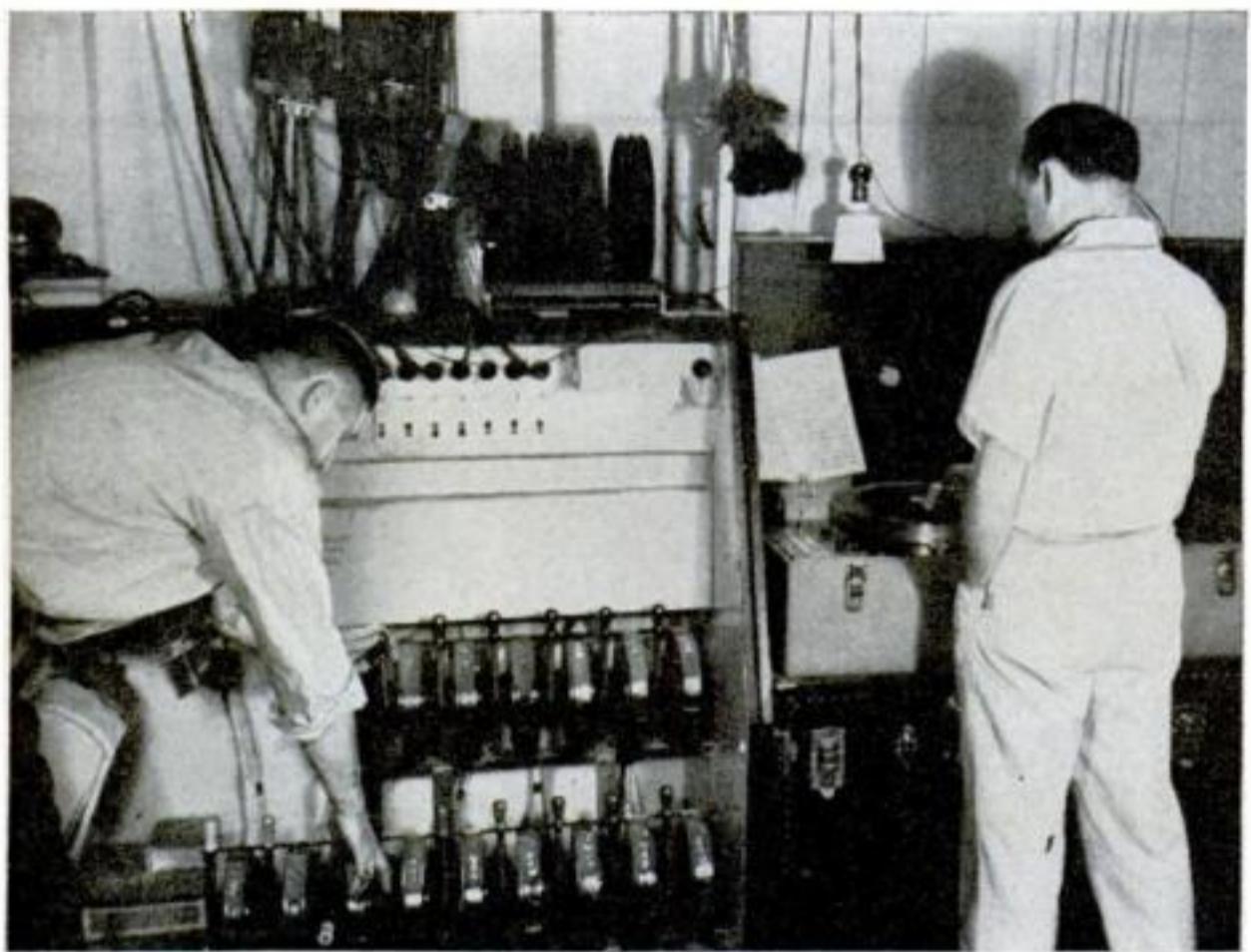
A chandelier used in "La Traviata" was constructed from 3,000 crystals, and another for "Rigoletto" was made of brass and consists of sixty candelabra. In "Carmen," the soldiers' helmets are made of brass and fashioned entirely by hand. The felt hats in "Faust" were blocked on specially carved miniature wood hat blocks.

In this opera, "Faust," occur a few amazing tricks of puppetry. Mephistopheles, the devil, is made to appear and disappear out of sudden gusts of thin white vapors. Within sight of the audience, the old, white-bearded Faust is transformed suddenly into the young, dashing, beardless suitor of the beautiful Marguerite. The substitution is really adept sleight-of-hand, aided by a

trapdoor in the stage, while the gusts of "white vapors" are puffs of tobacco smoke, blown up through a slot in the stage by one of the puppeteers!

All the settings used in the puppet operas are adaptations of scenery used by the La Scala Opera of Milan, Italy, the Metropolitan Opera of New York, and the Chicago Civic Opera Company. To add to the realism, a twenty-one-piece puppet orchestra begins tuning up its fiddles before each act. A frowzy-haired puppet conductor, known intimately as "Toscanini," then appears, takes a bow, and proceeds to lead his orchestra in a beautiful overture.

This realism extends to every piece of



Behind the scenes of the puppet opera. On the left is the switchboard that controls the elaborate lighting effects, on the right the phonograph turntables. Above, a scene from "Faust," as seen from the wings

back-stage equipment. Scenery consists of regulation "flats," "drops," and "borders," with a blue cyclorama encircling the back of the stage. Flats are fastened to the forty-eight square feet of stage space with miniature stage braces. When scenes are shifted, drops that must be gotten out of the way are hoisted into a regular fly loft overhead. Specially built miniature spotlights and floodlights are all under the control of an elaborate switchboard.

The stage was constructed for extreme mobility, without a single nail or screw: By removing a few hooks, nuts, and wedges, the entire 3,000-pound structure can be dis-

mantled and made ready for shipment by truck in about half an hour.

Holding for himself the title of producer and director, Ernest Wolff now has eight assistants, including five puppeteers, an electrician, a sound man, and a business manager. Like himself, all his puppet operators are linguists and musicians. They learn every opera by heart, and try to express each nuance of word and musical movement through the motions of the tiny actors. Each opera requires a month of difficult rehearsing, during which Ernest sits out front, suggesting movements of puppets' heads, hands, and legs, synchronized with the recorded music, while the puppeteers beneath the stage take notes.

Even the sound man, who shifts the phonograph records and watches over the reproducing equipment, is a musician, and works from a musical score. Sometimes well-known American operatic stars, such as Lily Pons, Helen Jepson, or Lawrence Tibbett, are cut into an opera to sing a famous aria. In each case, the sound man knows to a breath where the aria begins and ends on a record. Often the real-

ism is so great, and the music so moving, that audiences have been known to rise after an aria, shouting "Bravo! Bravo!" and refusing to quiet down until the puppet gave an encore!

In the course of his cross-country tour, combined with special engagements of longer duration, Wolff has exhibited his puppet operas to more than a quarter of a million people. Musicians and educators have acclaimed his work for its value in spreading the appreciation of operatic music. And, he has brought a new experience into the lives of thousands who would never have set foot inside a great opera house.



Cellar Periscope Shows Gas Meter

THE gas man won't track dirt through your kitchen to the cellar door any more if your house is equipped with the novel device shown above. Actually a periscope, it is attached outside the house with the lower end against a hole in the foundation. The meter reader simply looks into a convenient window at the top and sees the reflection of the meter dial through a system of mirrors in the periscope.

Physical benefits both of rowing and horseback riding are obtained on this exercising machine



Riding and Rowing Machine in One

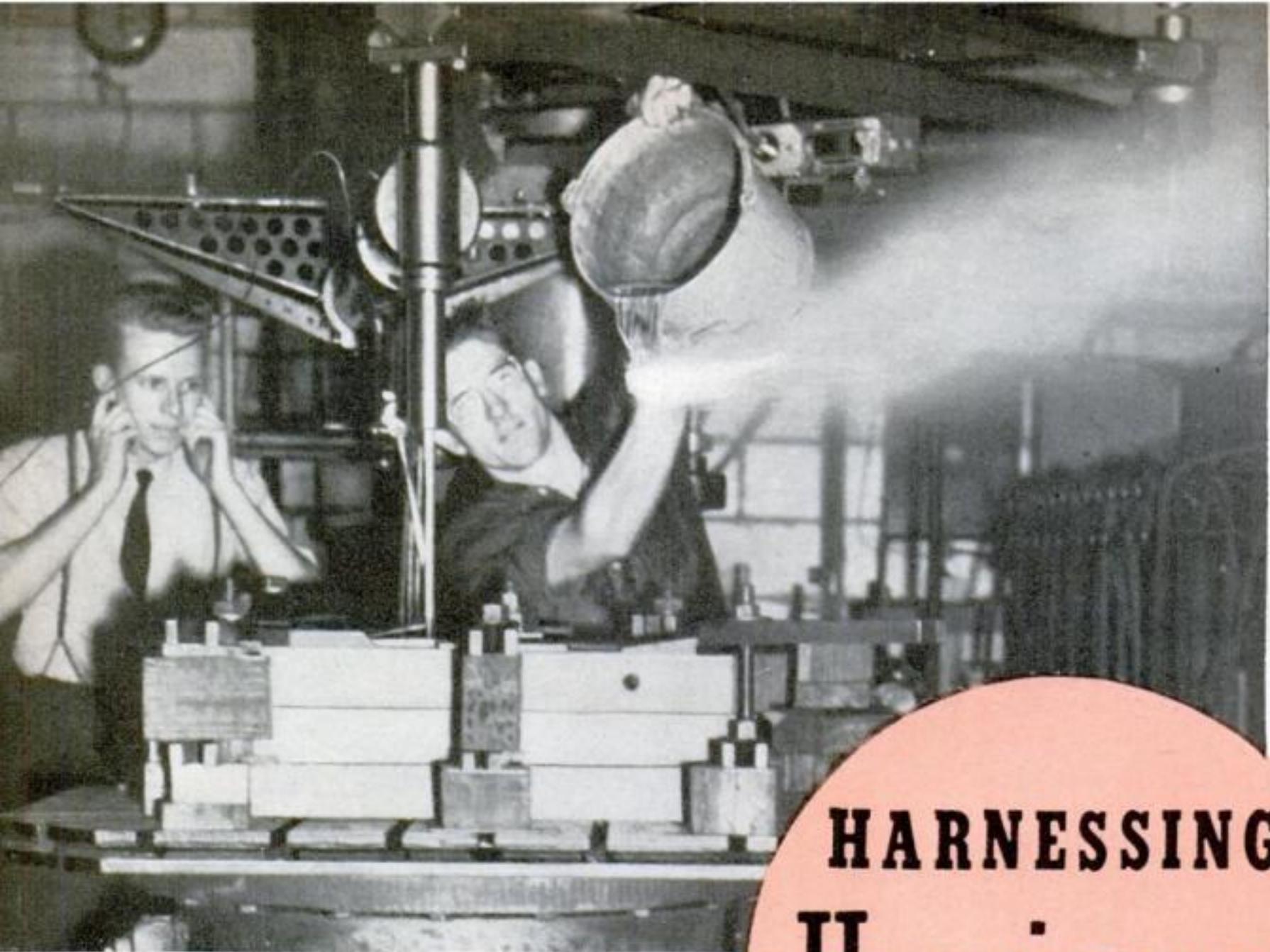
SAID to provide the healthy exercise of both rowing and horseback riding, a new machine, shown in use above, has hinged handlebars, foot rests, and seat which move through arcs to simulate the beneficial motions of both sports. A hydraulic piston provides resistance.



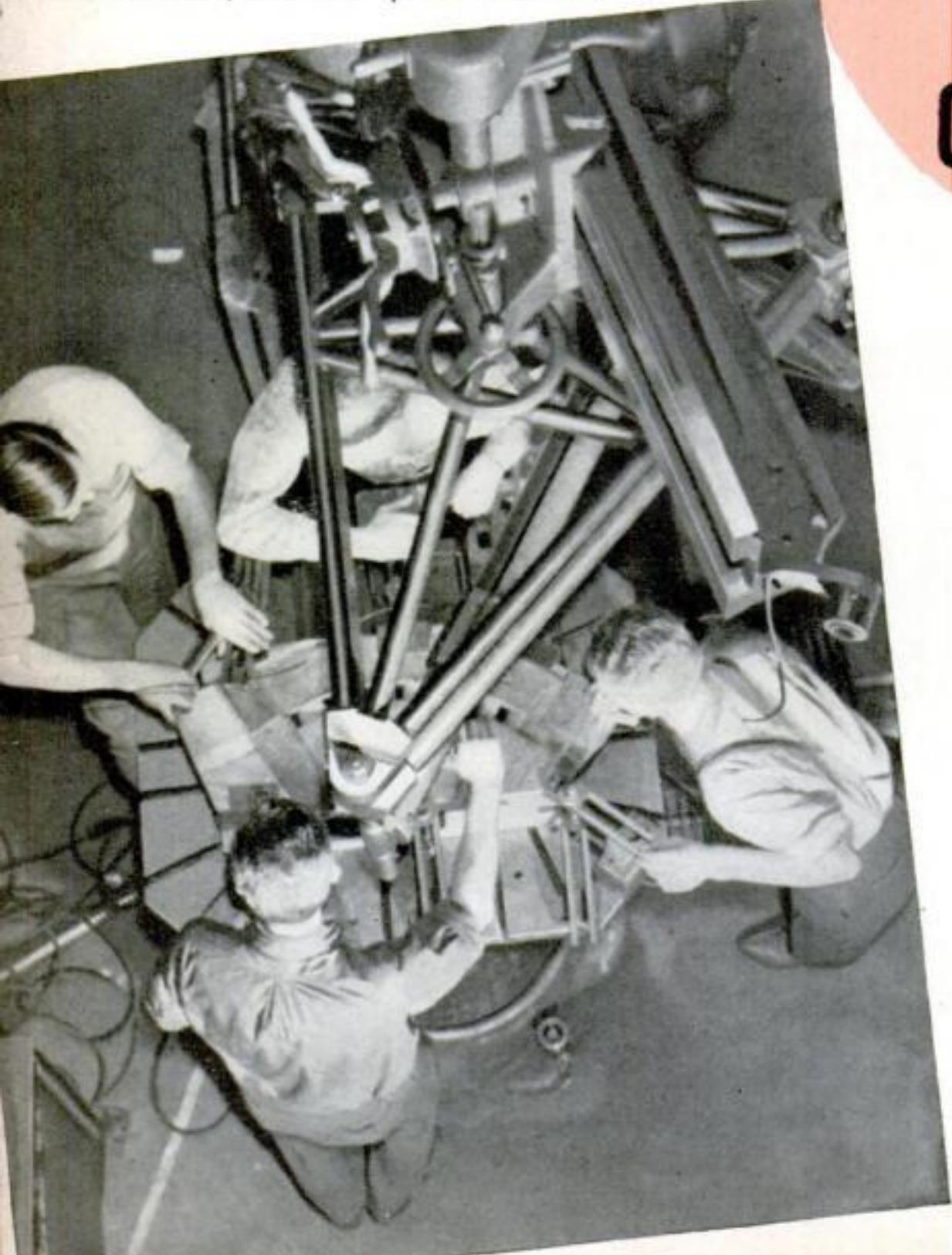
A germ death-ray cabinet installed in a Philadelphia, Pa., drug store

"Death Cabinet" Kills Germs on Drinking Glasses

DRINKING glasses placed in the cabinet at the left after washing are kept sanitary until removed, according to the manufacturer of the device. Designed for restaurant use, the glass-lined cabinet contains "cold-light" electric lamps which give off rays that kill disease-spreading germs that might linger on the rims or inside of the glasses while they are not in use.



Water poured into the high-velocity air stream from a model turbine-nozzle assembly is stopped in mid-air. Below, model clamped to test stand

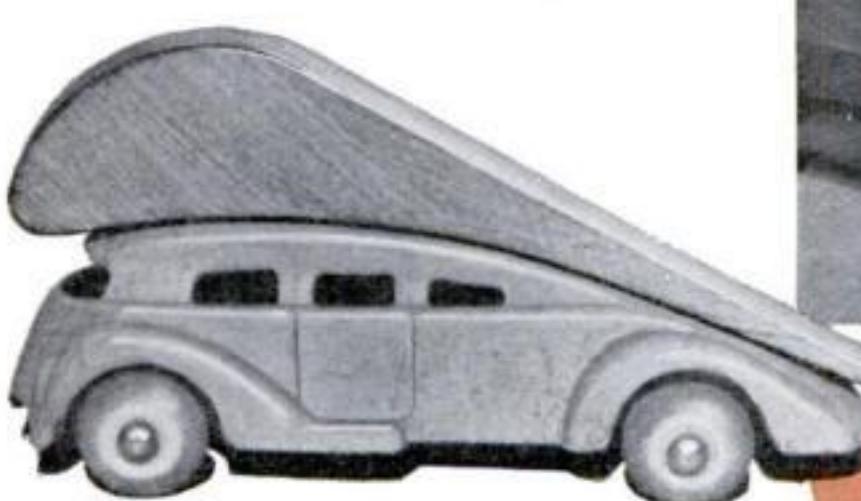


HARNESSING Hurricanes of Steam

RISING to a crescendo of sound so loud that a man cannot hear himself yell, the shriek of a dozen hurricanes fills a laboratory at Schenectady, N. Y. A pair of General Electric research engineers, wearing plugs in their ears, talk to each other only in sign language. With the aid of a wooden model faced with slots, like the front of an old-fashioned phonograph, they are testing the design of steam nozzles for a mighty 100,000-horsepower turbine.

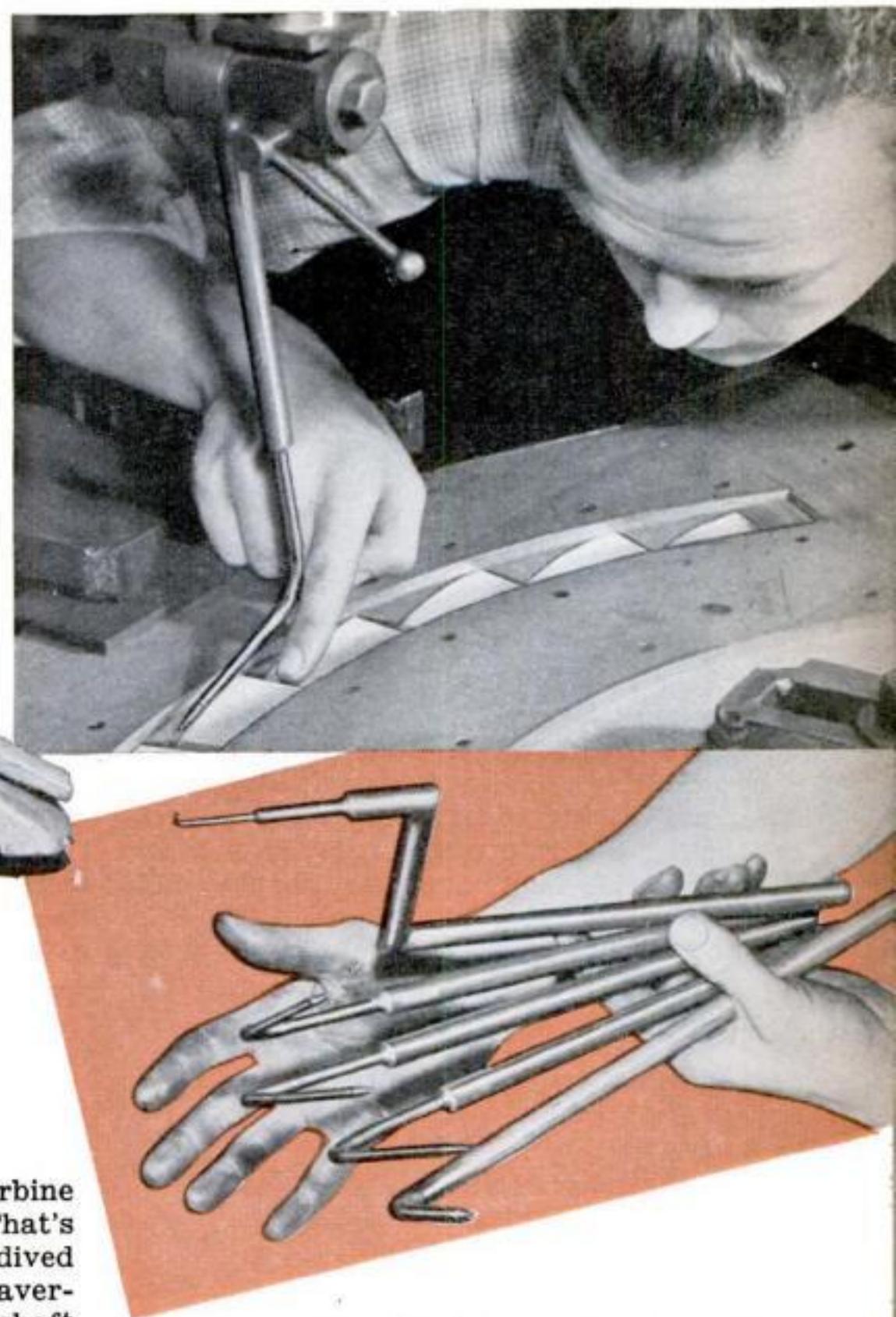
Super-streamlining is their job. Every obstruction they can remove from the path of steam in a turbine improves its efficiency, and contributes to modern living, for steam turbines last year accounted for about two thirds of the \$2,000,000,000 worth of electricity generated in the United States. Today these machines rep-

HOW ENGINEERS APPLY STREAMLINE DESIGN IN HIGH-POWER TURBINES THAT TURN THE WHEELS OF MODERN INDUSTRY

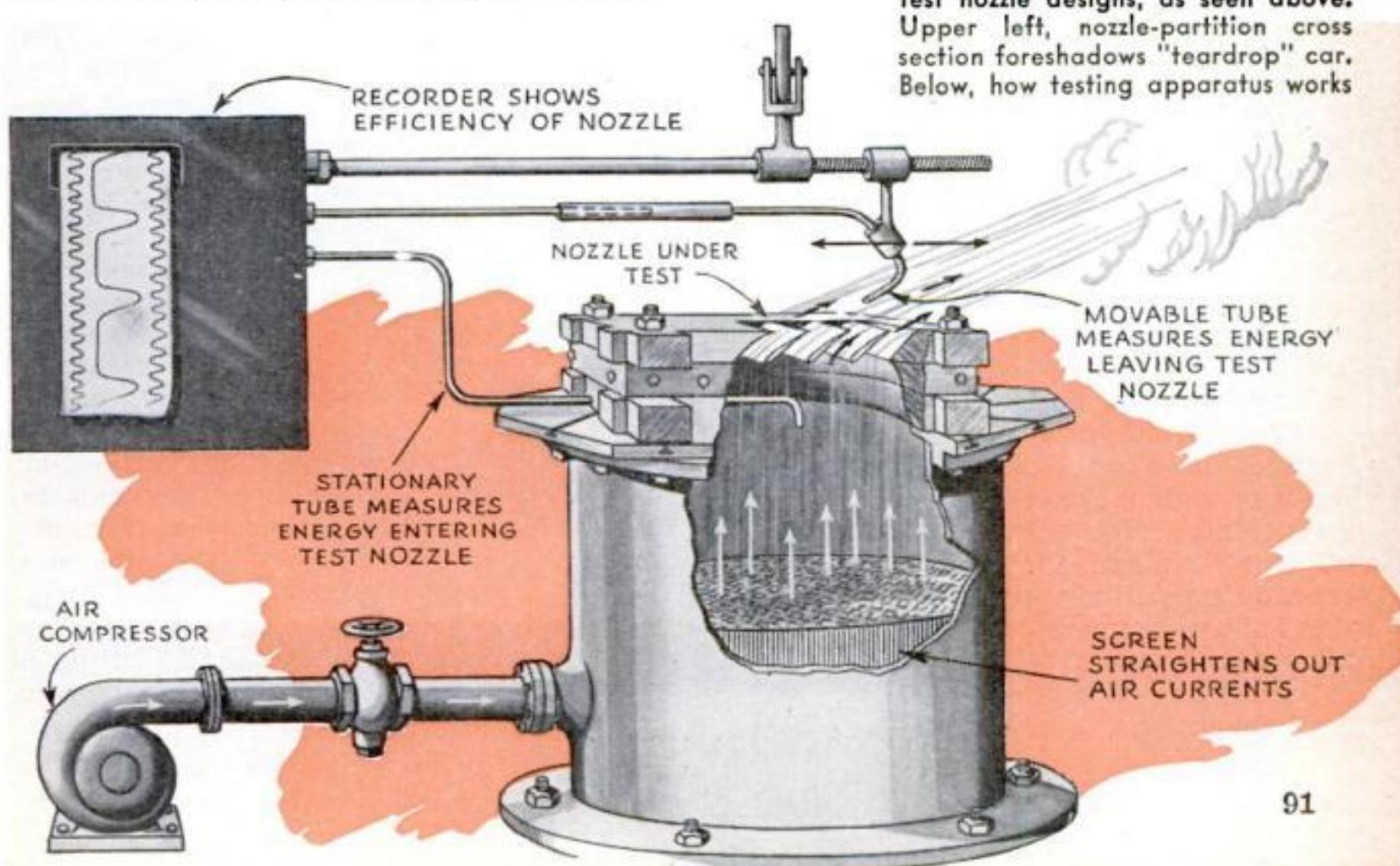


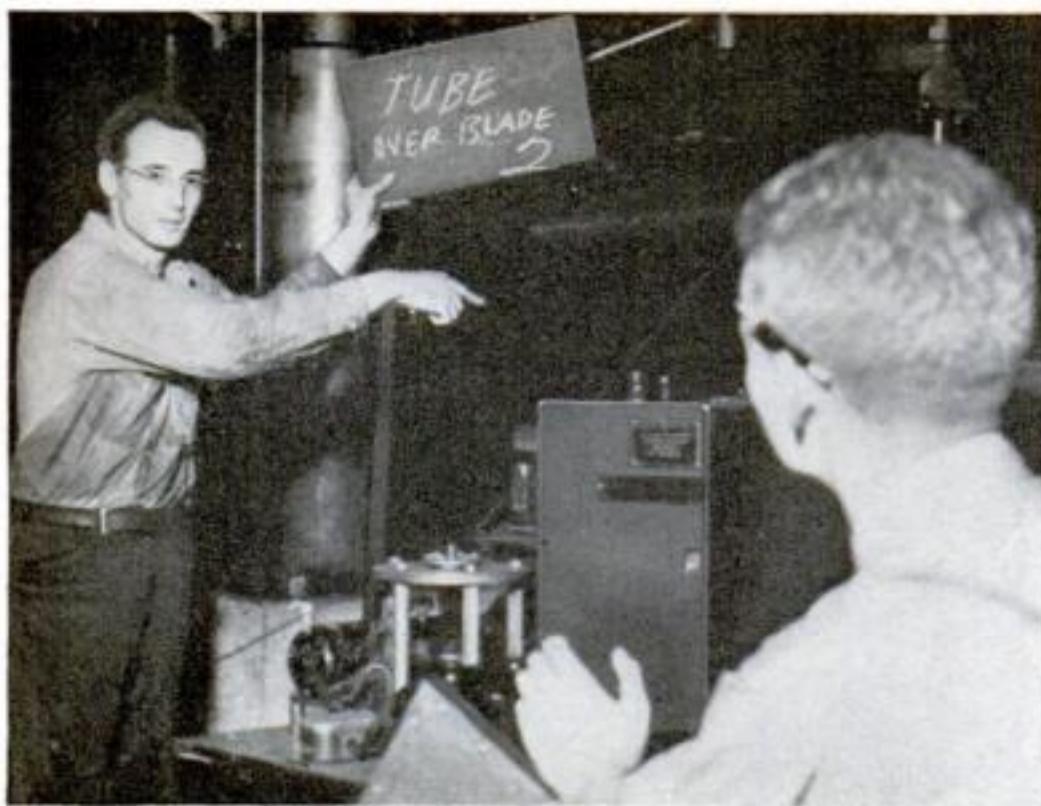
resent the nearest thing to perfection in streamlining. Few people know it. You don't see the streamline design when you look at a turbine, because it's on the inside.

Automobiles, trains, and planes poke along at a leisurely pace compared to steam rushing through a turbine at speeds up to 1,200 miles an hour. That's twice as fast as man has ever power-dived in aircraft; twelve times as fast as an average hurricane. Mounted on a single shaft within a big turbine, as many as twenty-



Fingerlike impact tubes are used to test nozzle designs, as seen above. Upper left, nozzle-partition cross section foreshadows "teardrop" car. Below, how testing apparatus works





Terrific noise of the tests makes sign language necessary

three bucket wheels, resembling multi-bladed fans, harness the steam as a windmill does a breeze. For utmost efficiency, the bucket wheels must have the steam directed against them at just the proper angle by fittings called nozzles. These are the parts that call for streamline precision.

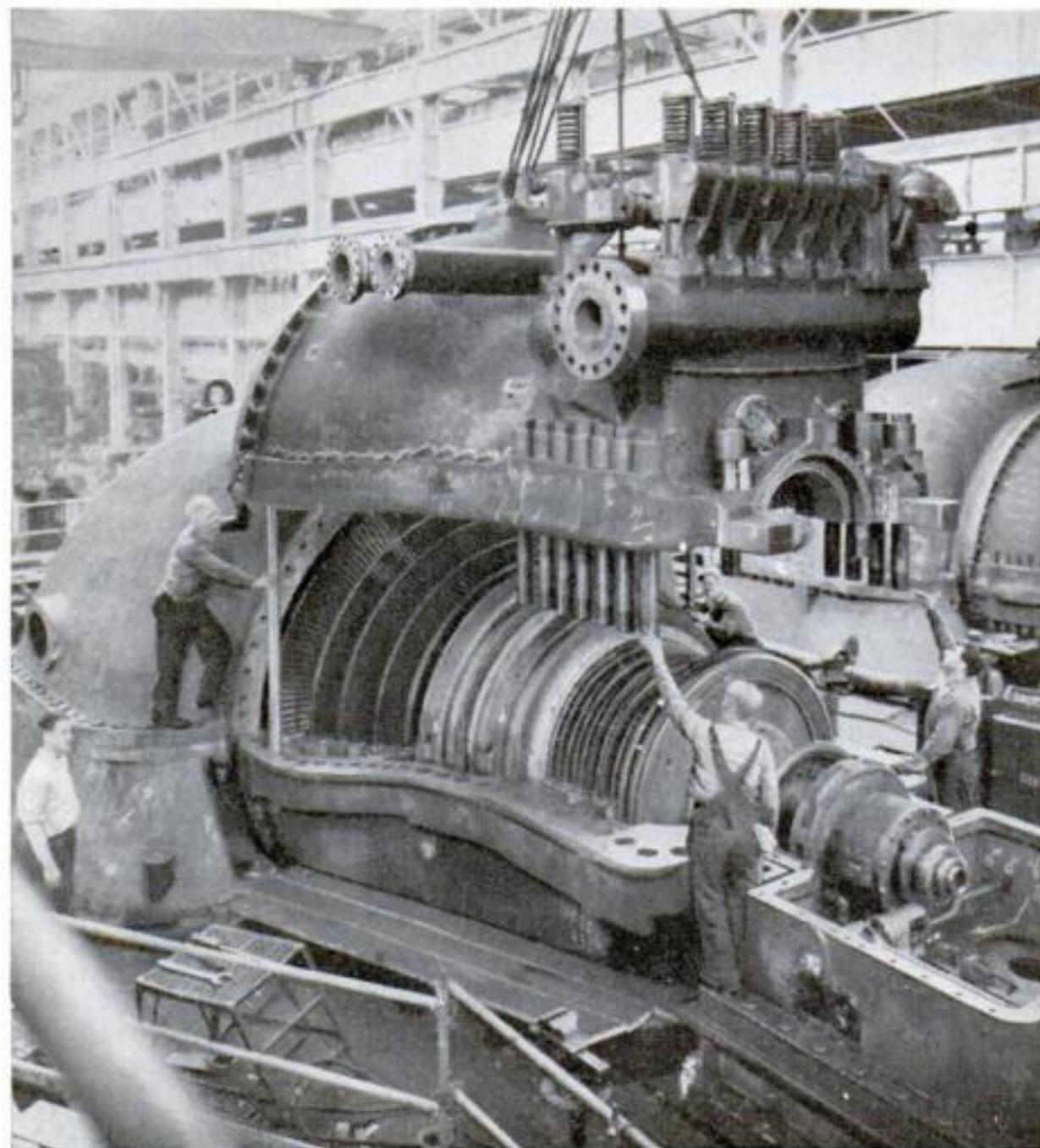
Unlike the nozzle of your garden hose, turbine nozzles are slit-like openings, in diaphragms before each bucket wheel. How they have been developed to guide the twenty-mile-a-minute steam flow, while absorbing only two percent of its energy, is an interesting story.

Away back in 1920, before much was known about streamlining, a General Electric executive puzzled over a drawing of a turbine nozzle. To visualize it better, he ordered a wooden model made. Someone suggested blowing air through it. Merely out of curiosity, a young engineer stuck his finger in the air stream. At some spots he felt "holes" or air pockets. That brought the whole engineering staff over to poke their fingers into the stream of air, too. They realized that here was a positive way to find out where nozzles obstructed a steam jet.

From that crude beginning has sprung the lat-

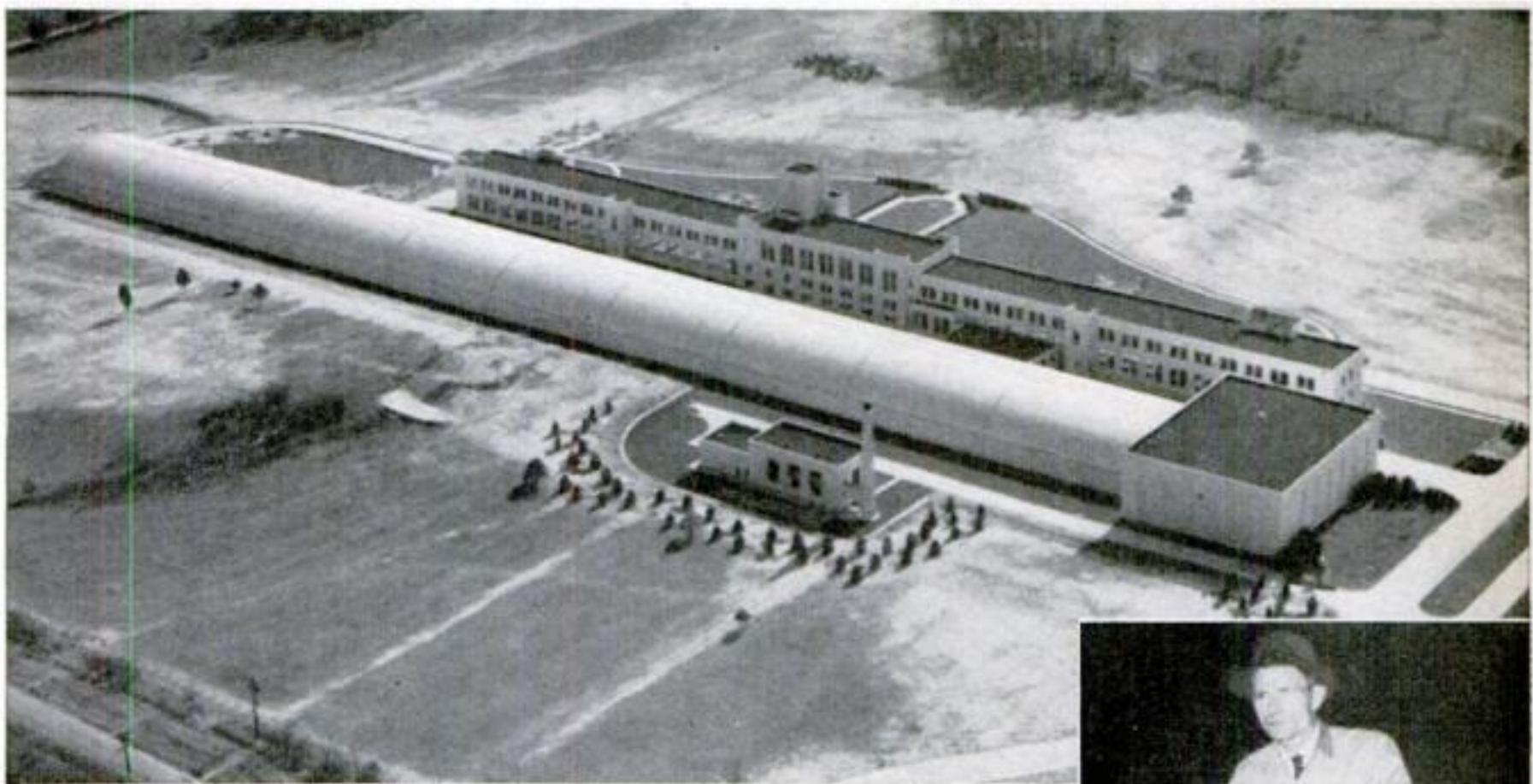
est way of "putting the finger" on eddy and friction losses. In a special laboratory, engineers clamp a model of the nozzle to a test stand. Air is blown through the model at the terrific velocity of steam going through a turbine. To do the feeling, mechanical fingers take the place of human ones. Openings in their tips deliver air-pressure readings to an automatic recording machine, and zigzag lines marked by a pen on a continuously moving strip of paper reveal the overall efficiency of the nozzle. Any bad spots that need to be corrected are also indicated. A teardrop shape has proved best for the slots, as for other streamline objects, in these tests.

So forceful is the horizontal jet of air issuing from a model under test that a pailful of water may be emptied into it, without spilling a drop on the floor. The air simply blasts the water into mist. With a sound meter, the noise of the man-made hurricane has been found to be more than a third as great as that of Niagara Falls.



Inside of a turbine. Nozzles in the casing direct steam against the blades

Bikes Save Time at Navy Testing Basin



It takes four and a half minutes to walk the length of this ship-testing basin. So employees now cover it on bikes, as at the right

SO BIG that the Government has furnished four bicycles for the use of the scientific and operating staffs in getting from one point to another along the walks besides its indoor waterways, the U. S. Navy's giant ship-testing basin at Carderock, Md., (P.S.M., Jan. '38, p. 36) is as long as four football fields laid end to end. Replacing the old testing basin at the Washington, D. C., Navy Yard, the new establishment features two channels of water, with a turning basin and laboratory building at one end. Along these miniature oceans that can be whipped up by artificial means to simulate conditions on the high seas, naval experts send scale models of proposed warships for exhaustive trials. As a result of these realistic tests, the scientists obtain invaluable data on various factors of design and operation.



New Table-Top Golf Game

Blindfolded, a player tries to draw a pencil line past hazards from a "tee" to a cup



A PENCIL substitutes for a club in a novel table golf game recently introduced. The player, blindfolded with a black mask, makes "shots" by drawing a line from the tee in the direction of the green on a course marked off on a pad made of transparent cellulose material. After each "shot" the player raises the mask, judges the angle and distance for the next "shot," replaces the mask, and draws another line. This process is repeated until the line meets the cup.

They Travel To Keep Motorists Posted



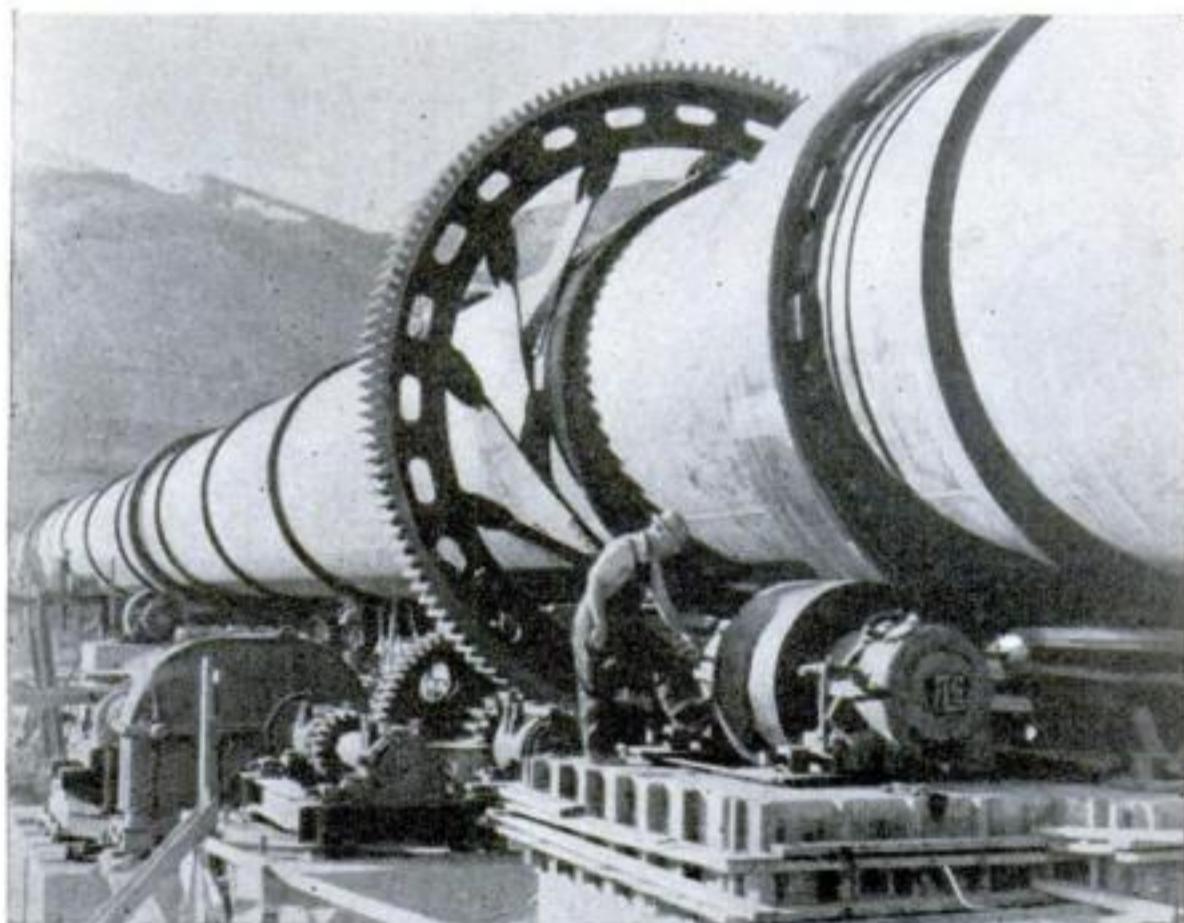
A signpost crew settling down for a good night's sleep in the truck that serves as a home on the road. Below, setting up a new warning for drivers



LIVING like gypsies in their own trucks, signpost crews of the Automobile Club of Southern California have erected 500,000 signs of 125 types in their area. They cover 200,000 miles a year, posting 50,000 signs annually to keep abreast of changing road conditions. Often the crews are gone from headquarters ten days at a time, sleeping in beds which swing down from the roofs of their trucks and cooking on gas stoves which slide out onto the back platform.

Big Kilns Make Cement for Dam

BUILT especially for the job, giant rotary kilns now in operation at the construction site of the huge Shasta Dam in California, convey an idea of the immensity of the project. Twelve feet in diameter, each of the two rotary kilns is able to turn out 7,000 barrels of cement a day to meet the expected total requirement of 5,800,000 barrels of cement for the complete dam. The turning mechanism for one of the kilns is pictured at the right.



One of the two huge rotary cement kilns at the site of the Shasta Dam

Road Test

It's a thought to suggest
That the acidest test
Of your worst—or your best—
Is a car.
When you sit at the wheel
Of an automobile,
You are bound to reveal
What you are!

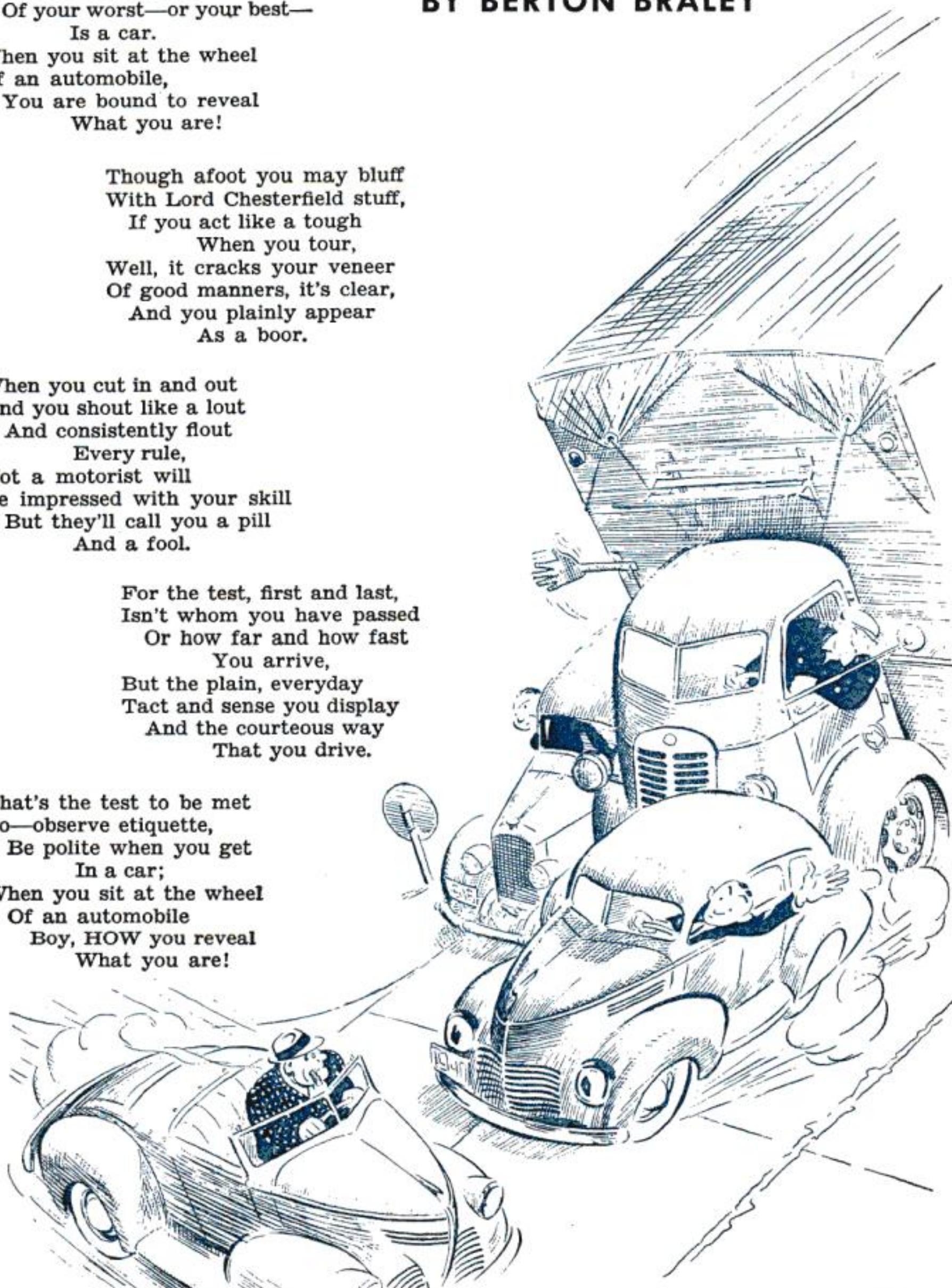
BY BERTON BRALEY

Though afoot you may bluff
With Lord Chesterfield stuff,
If you act like a tough
When you tour,
Well, it cracks your veneer
Of good manners, it's clear,
And you plainly appear
As a boor.

When you cut in and out
And you shout like a lout
And consistently flout
Every rule,
Not a motorist will
Be impressed with your skill
But they'll call you a pill
And a fool.

For the test, first and last,
Isn't whom you have passed
Or how far and how fast
You arrive,
But the plain, everyday
Tact and sense you display
And the courteous way
That you drive.

That's the test to be met
So—observe etiquette,
Be polite when you get
In a car;
When you sit at the wheel
Of an automobile
Boy, HOW you reveal
What you are!





Louise Paine, right, and students of the Otis Art Institute in Los Angeles, Calif., at work on a pictorial history of the earth

Earth's History in 300-Foot Painting

A HISTORY of the earth from the beginnings of time, in one gigantic block-long painting, was a high spot in a recent exhibit of mineral lore held in Los Angeles, Calif. In planning the mammoth canvas, the artists discovered that if an ordinary arithmetical scale were used, the whole history of man would take up only two inches. They therefore adopted a geometrical plan in which one ten-foot panel represented 1939, the second ten-foot panel the two years 1938 and 1937, the third panel the four preceding years, and so on until the final panel represented a period of 1,000,000 years.



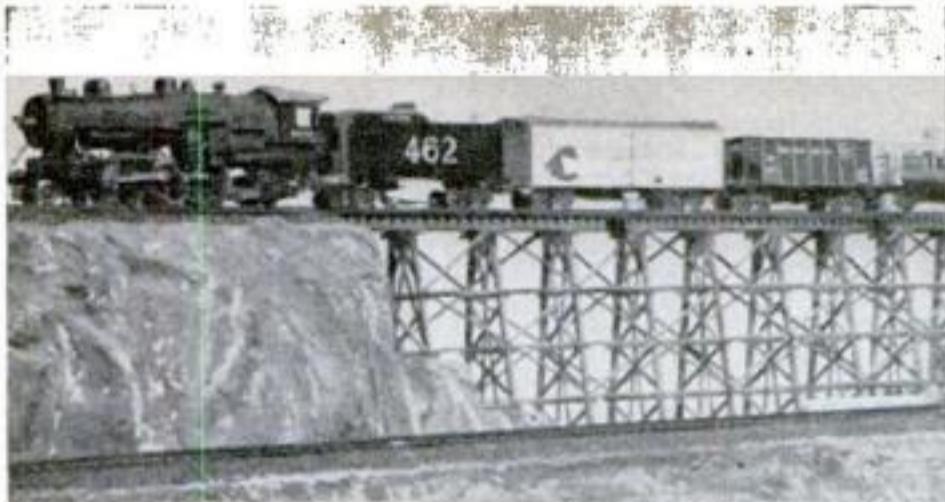
Adjustable Generator for Small Planes

INCASED in a stream-line housing, a new type of wind-driven generator for small airplanes has blades that can be adjusted to various pitches to increase or decrease the turning rate and power generation. The blades are locked onto the main shaft by means of a special type of set screw which makes it practically impossible for them to fly off. The new device was developed by A. J. Baxter, a pilot flying out of Floyd Bennett Field, New York City.

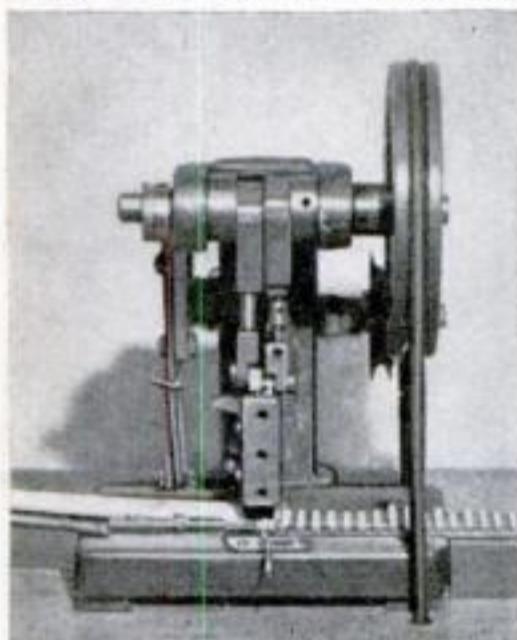


Adjusting blades of new generator and, right, attaching it to the fuselage of a plane

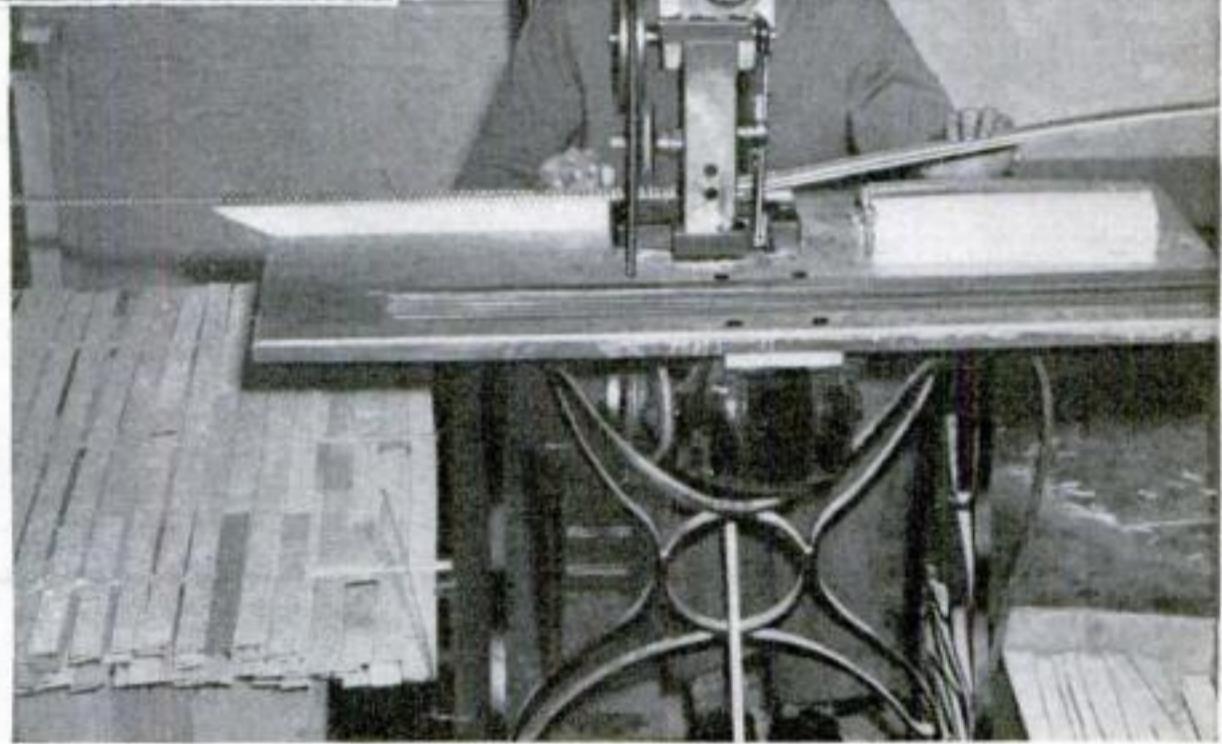




Model trestle equipped with track from the new machine



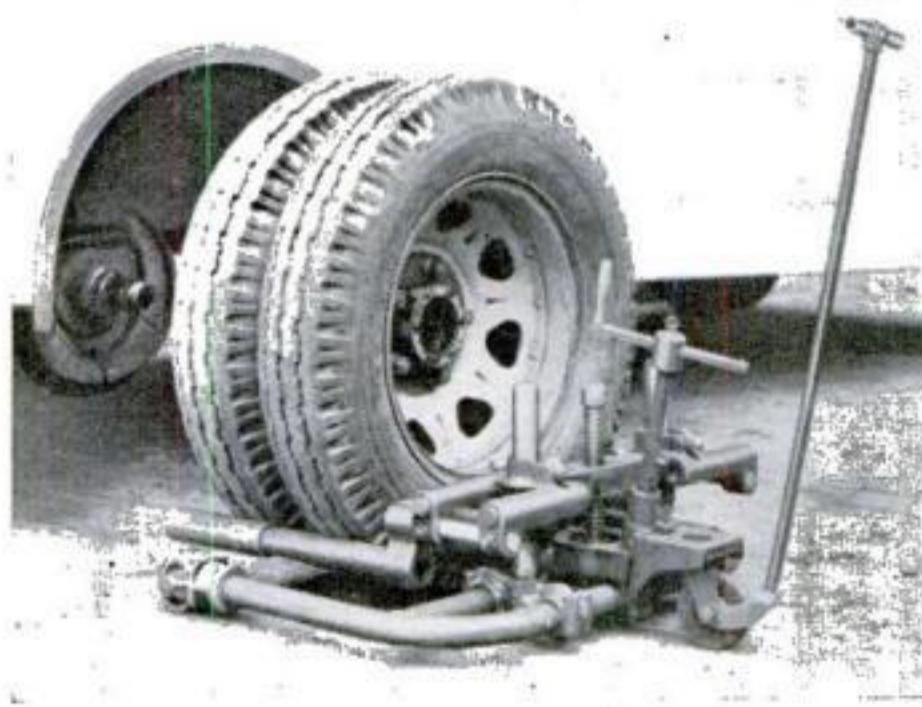
Rails and ties being joined



Fred J. Chemidlin at work on the track-assembling unit he invented

RAILS and ties are assembled automatically without the use of spikes by a novel machine invented by Fred J. Chemidlin, of Scotch Plains, N. J., to manufacture track for model-railroad enthusiasts. Re-

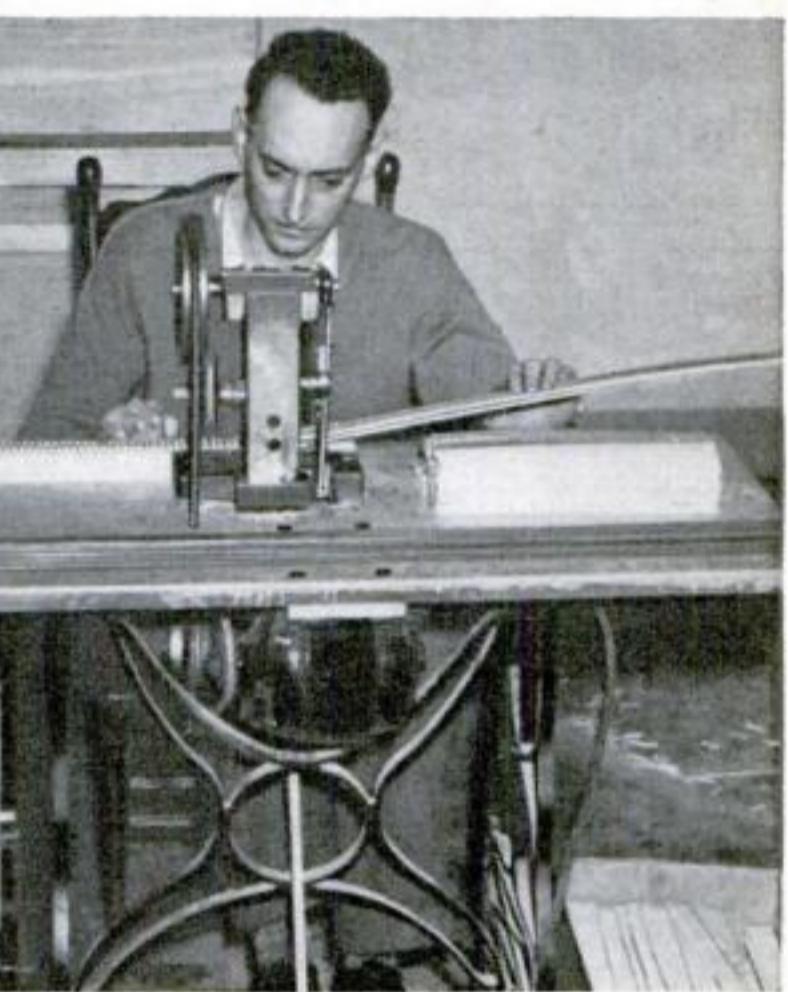
sembling an old-fashioned sewing machine, the device turns the finished product out in a steady stream. Although the original machine was hand-powered, a new type is powered by electricity.



Dolly Eases Big Tire Jobs

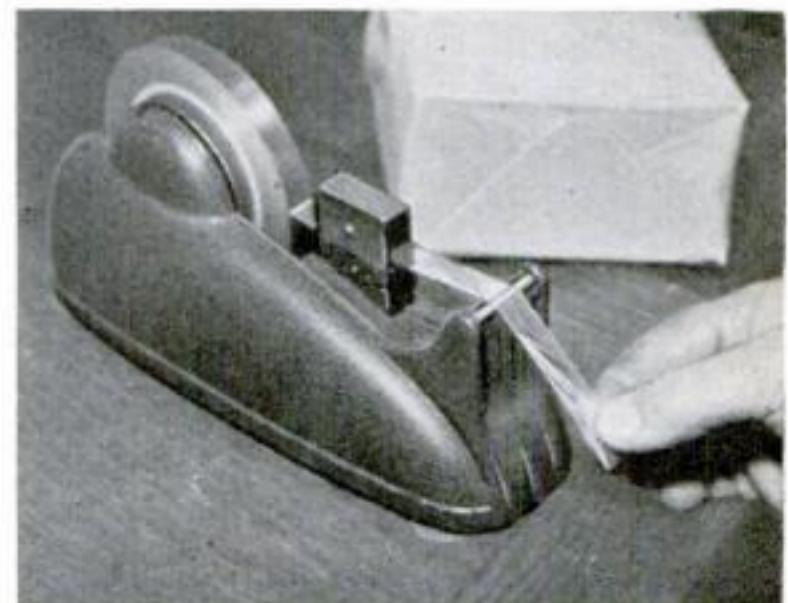
CHANGING huge truck wheels for tire repair or replacement is made easy by a new mechanical wheel dolly. With the apparatus, pictured above, one man can easily remove a double-wheel assembly and transport it to any part of a repair shop.

Machine Makes Track for Model Railroads

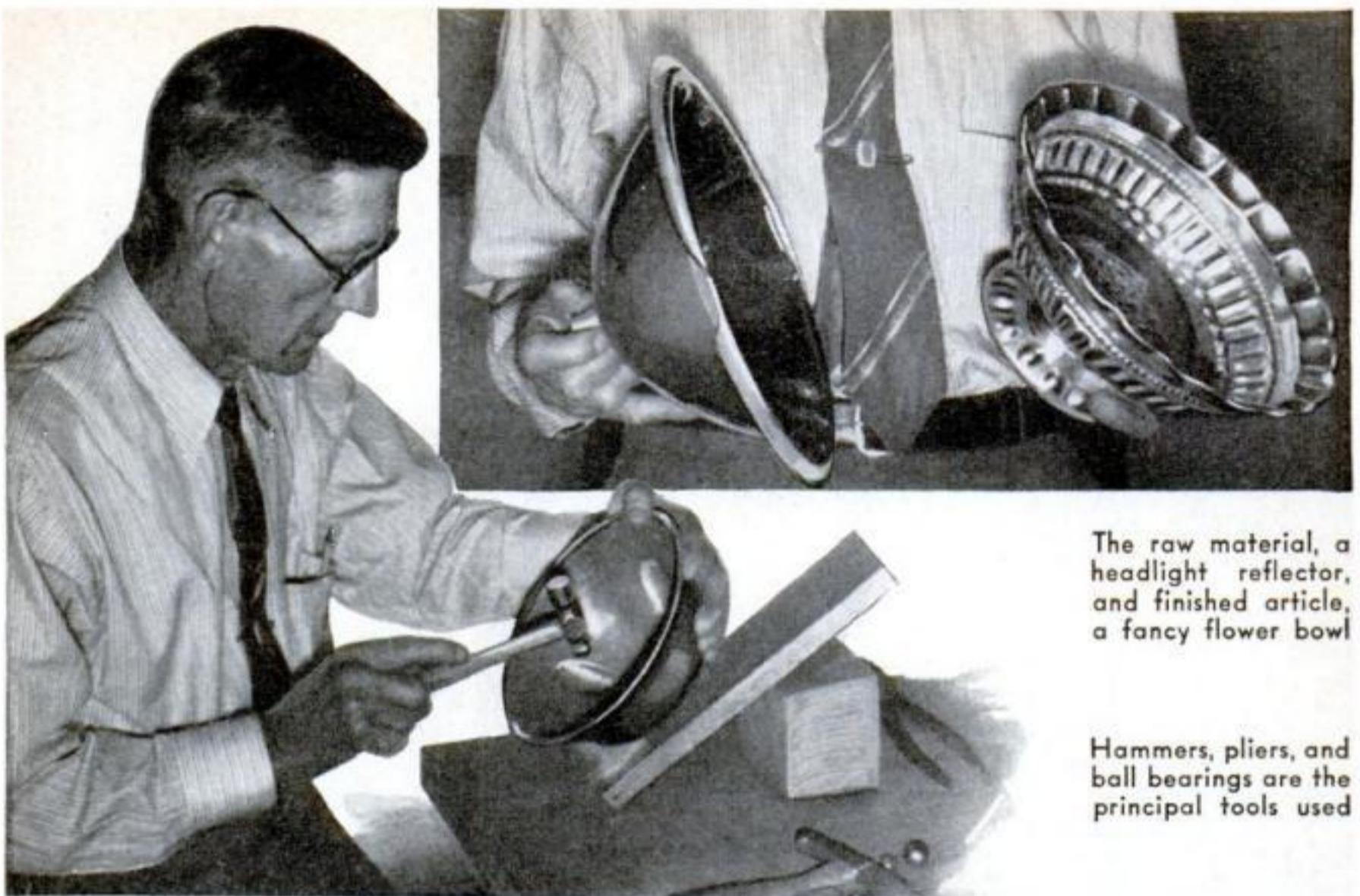


Device Puts Printing on Wrapping Tape

PRINTING is applied to the adhesive face of transparent cellulose tape as the latter is fed from a new counter-top dispensing device. Changeable printing wheels bearing different messages do the work.



Tape is printed as it comes from the device



The raw material, a headlight reflector, and finished article, a fancy flower bowl

Hammers, pliers, and ball bearings are the principal tools used

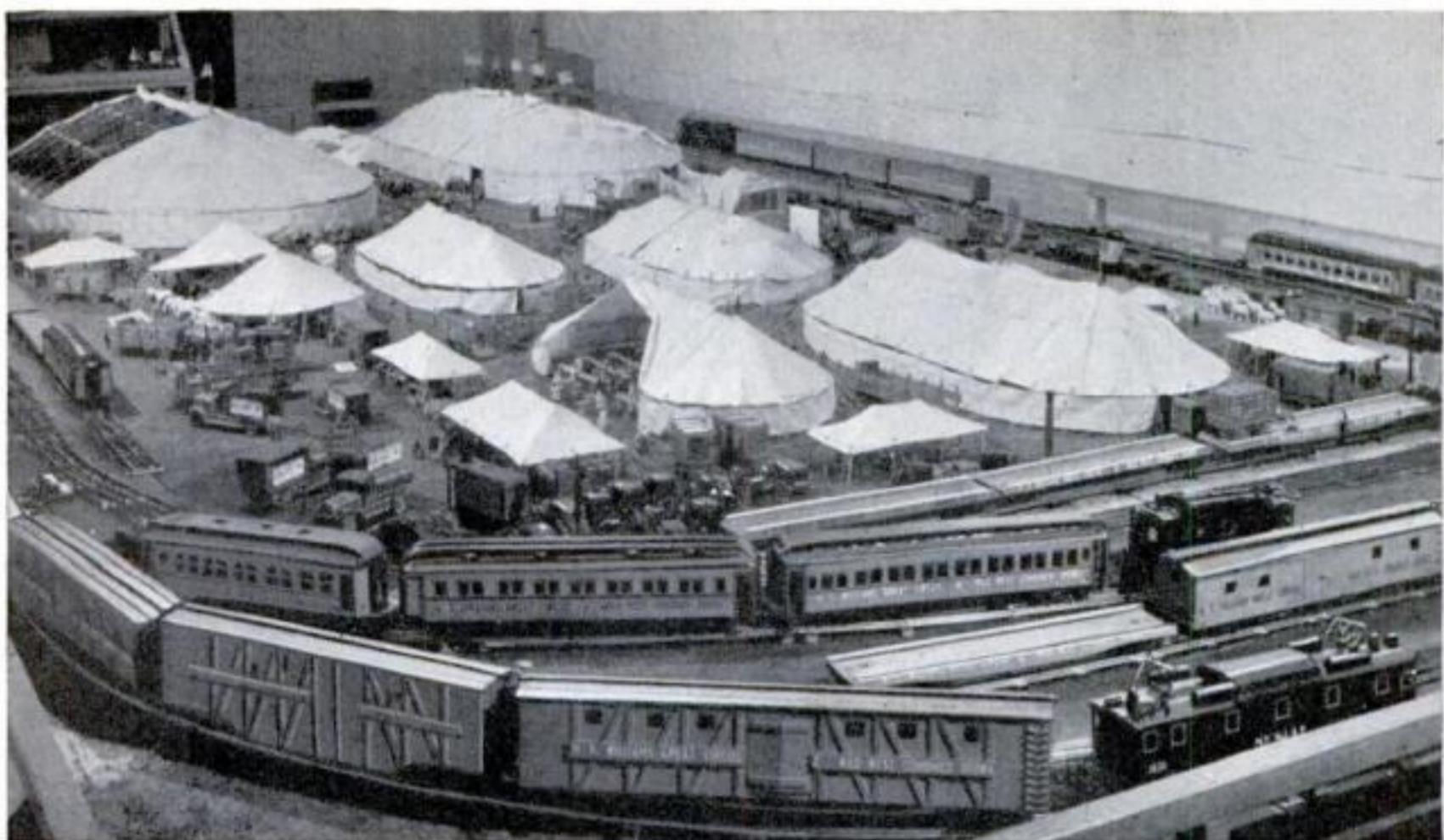
OLD AUTO HEADLIGHTS MADE INTO FANCY BOWLS

WHEN time began to hang heavy on the hands of sixty-two-year-old Leo Giesecke, retired Houston, Tex., sheet-metal worker, he conceived the idea of fashioning decorative bowls and vases from the reflector shells of junked automobile headlights. At a workbench in his garage, Giesecke pounds out artistic designs with the aid of simple tools. Ball-headed hammers in different sizes are used to rough out designs in the brass reflector shells, pliers aid in bending the metal, and ball bearings, struck with a hammer, make perfect indentations in the reflector surface. When the design of a particular bowl or vase calls for fashioning decorative feet or legs, these are made from sheet brass, and an occasional piece is nickel-plated. Because the hammering and bending tends to harden the metal, the shells have to be annealed several times while the work is in progress, to make it soft enough for working.

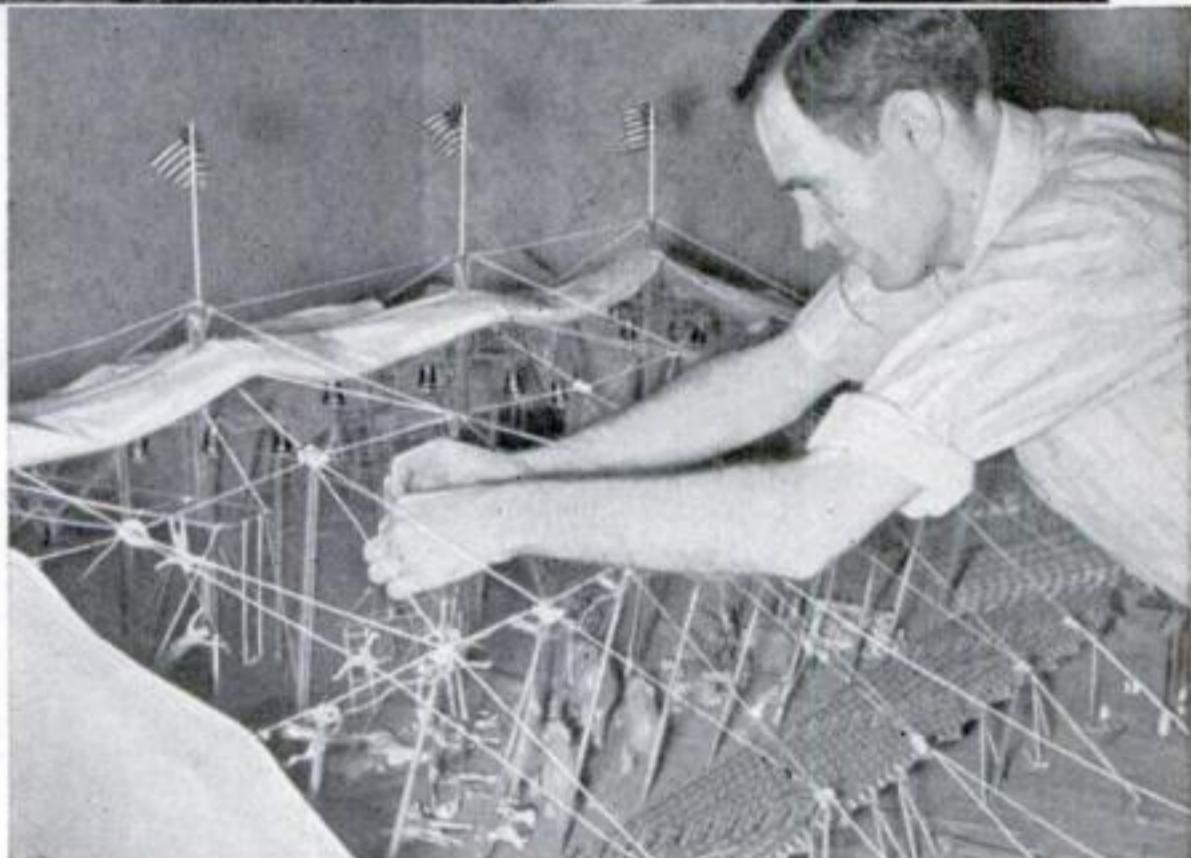


Leo Giesecke's workbench and several of his artistic products

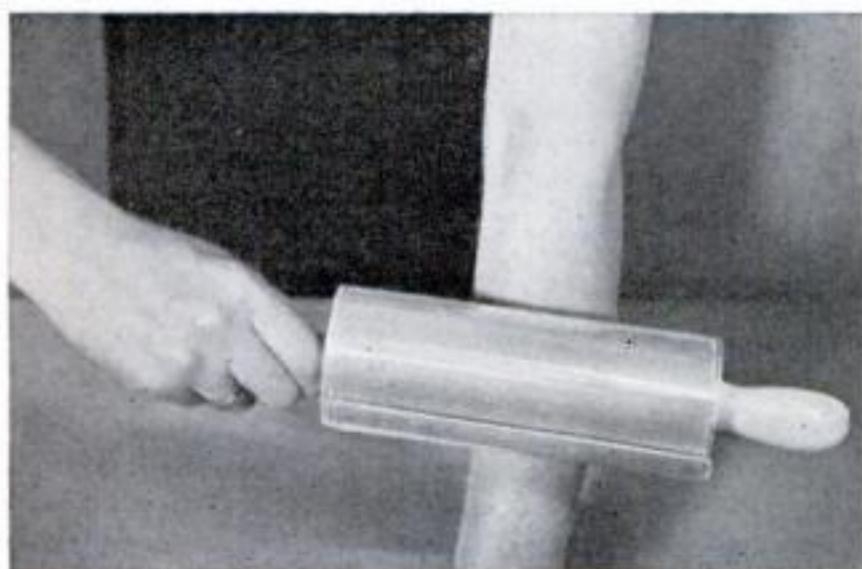
Model Circus Is Big Show in Miniature



FIFTY railroad cars, twenty-five tents, 100 wagons, forty-five different kinds of animals, and thousands of individual performers make up an amazing miniature circus that has been the spare-time hobby of Horace S. Williams, of Falconer, N.Y., for twenty-five years. Constructed on a scale of three-eighths of an inch to a foot, the portable show occupies an area fifteen by twenty-eight feet and requires four men four full working days to set up. After seeing the model, a veteran circus man set its value at \$25,000.



Horace S. Williams adjusting a trapeze under the big top of his huge circus model. The complete layout is pictured at the top of the page

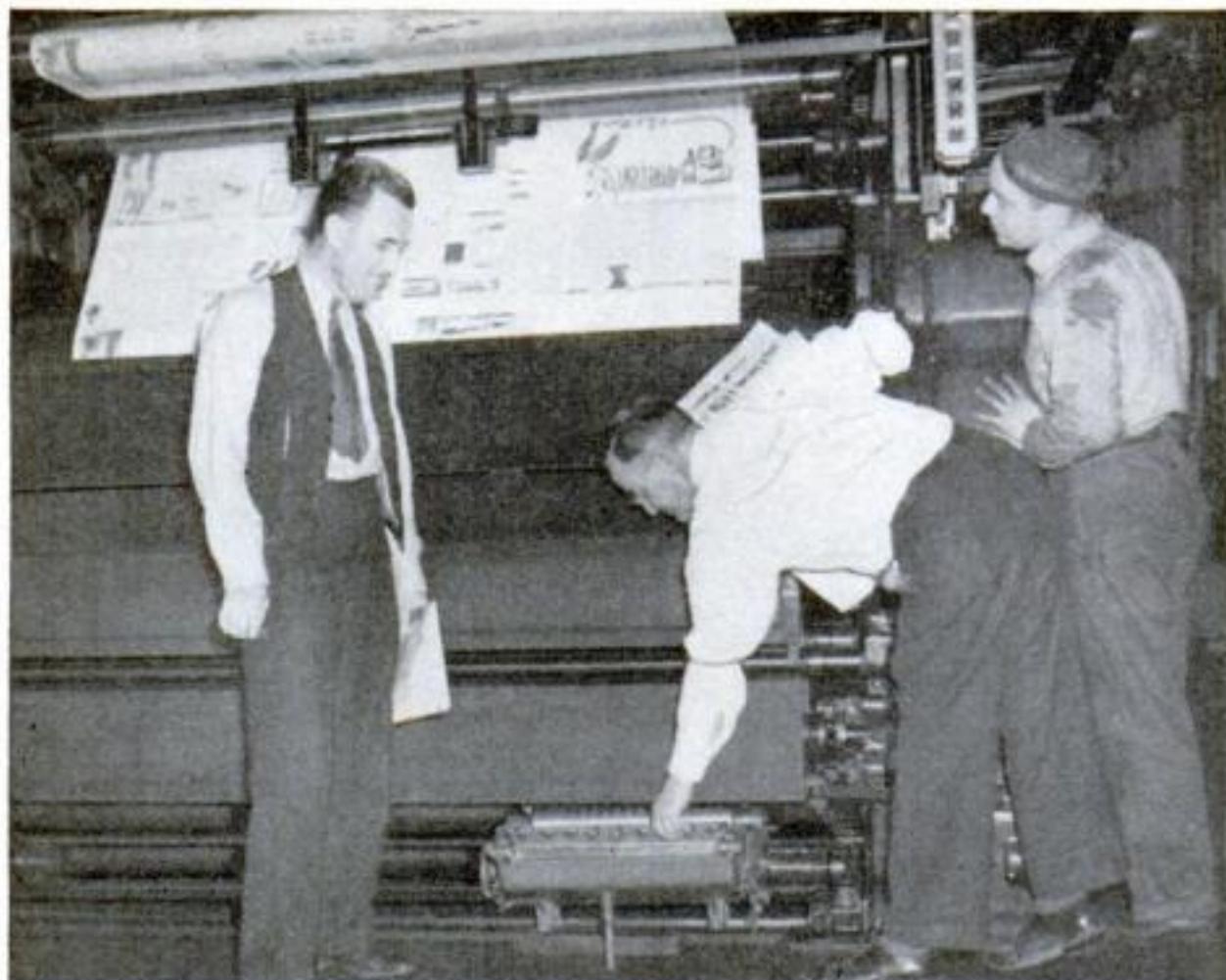


The one-pound bar of soap rolls on wooden handles

Rub Lather In, Fat Out, With Rolling-Pin Soap

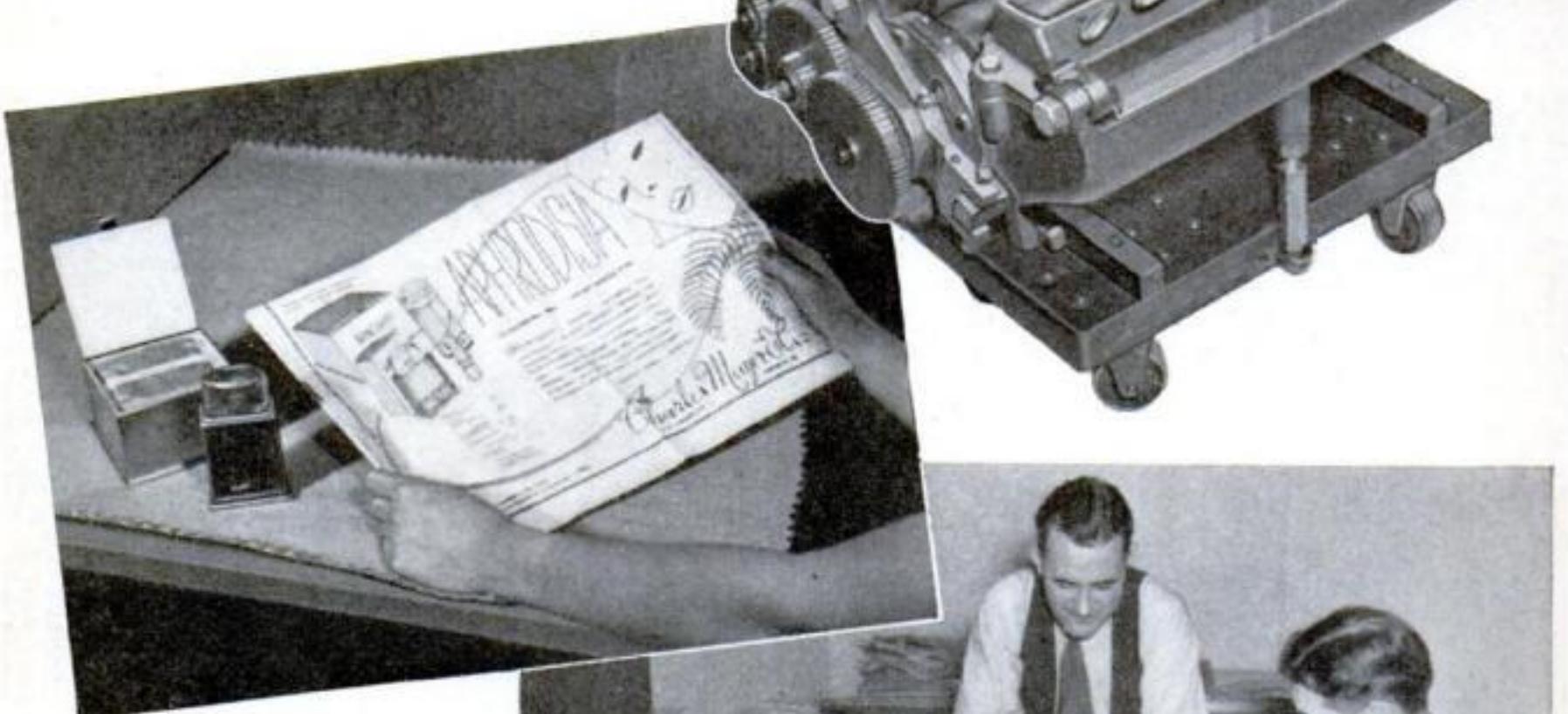
SOAP made in the form of a rolling pin is a novel bath accessory recently placed on the market. The cylinder of soap, weighing one pound, is fitted with wooden handles, making it easy for the bather to roll off excess fat while working up a lather by wielding the unit as pictured at the left. The novelty is available in three colors: White, scented with gardenia; peach, with geranium; and green, with pine.

Perfume Advertised in Perfumed Ink



A COLOR advertisement that smelled, but smelled beautifully, was printed recently in an Indianapolis, Ind., newspaper to promote the sale of a new perfume. To accomplish this novel feat, green printer's ink was scented by adding concentrated perfume oil, and applied to the page on which the advertisement appeared by means of a special "ink fountain" of the type used to print a color on a single page of a large newspaper. The unit, pictured below, can be attached quickly to the press.

Note the special "ink fountain" at bottom of the printing press above. Using it, the "Indianapolis Star" was able to print a perfume advertisement that gave off the odor of the perfume. At the right is shown a close-up of the ink-applying mechanism



The advertisement itself, above, was specially drawn so that it would use just the right amount of ink-perfume mixture. Right, the newspaper's mechanical superintendent and advertising manager are seen at work as they blended ink and perfume oils in carefully planned proportions before the press run



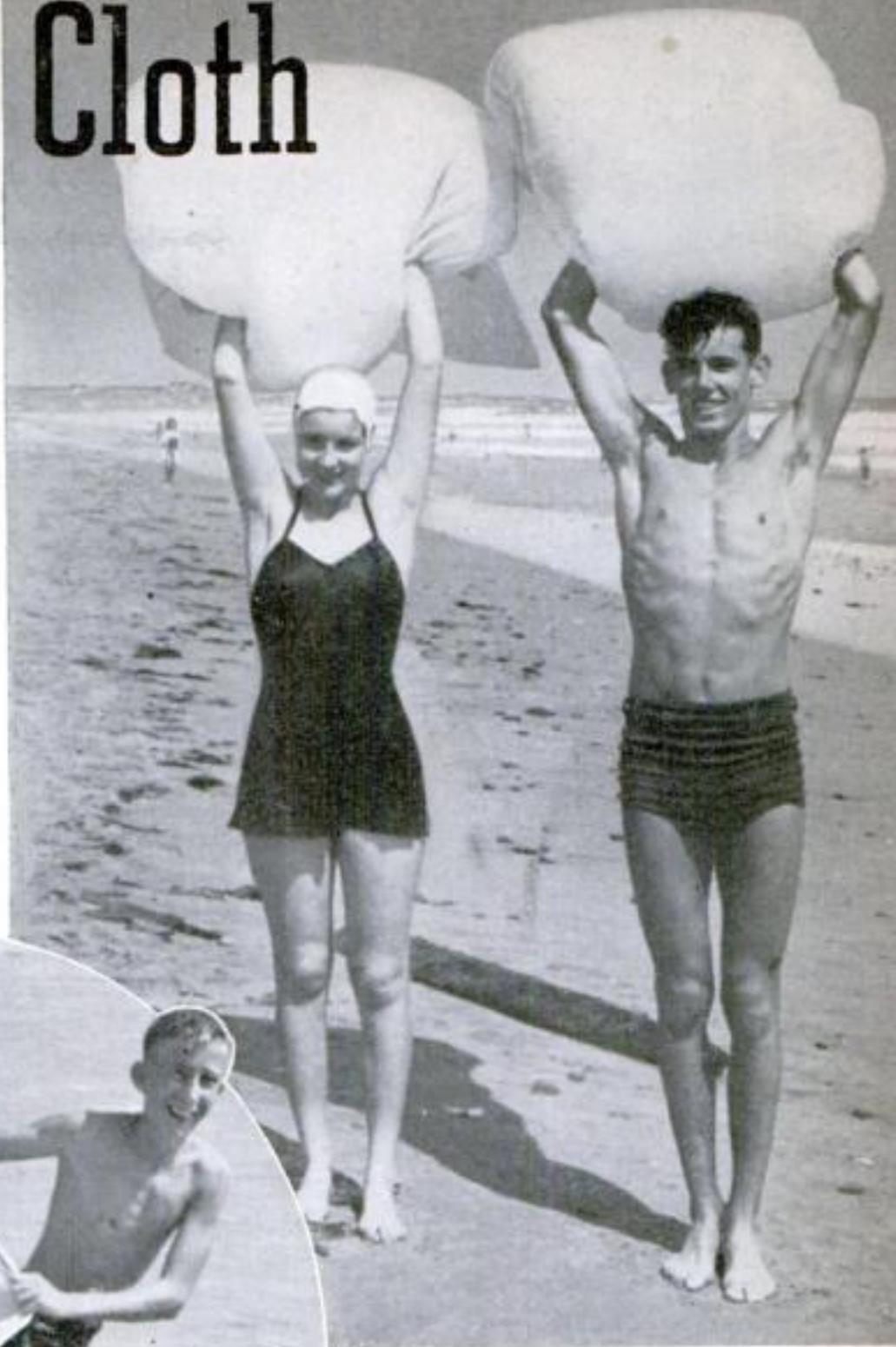
Surfboards of Cloth

RIDING the ocean breakers on surfboards made of cloth is a novel sport that is becoming popular at a California beach resort. Looking like a giant's pillowcase, the "boards" are made from four yards of good-quality muslin, which becomes air-tight when wet. The cloth is doubled lengthwise and sewed along both sides with a triple row of fine stitches. Around the open end a strong hem is stitched. In use, the bag is first thoroughly soaked, and then filled with air by holding it open to the breeze or running a few paces with it. With a quick downward motion, the open end is pushed under water to trap the air and twisted shut like a paper bag. The rider then grasps the twisted end and takes off into the swells.

Running with the cloth surfboard to "balloon" it full of air before use



Above, ready for the waves. Below, a group of enthusiasts ride toward the shore on their odd pillowcase mounts



make-Believe

TRAIN MEN FOR SALVAGE

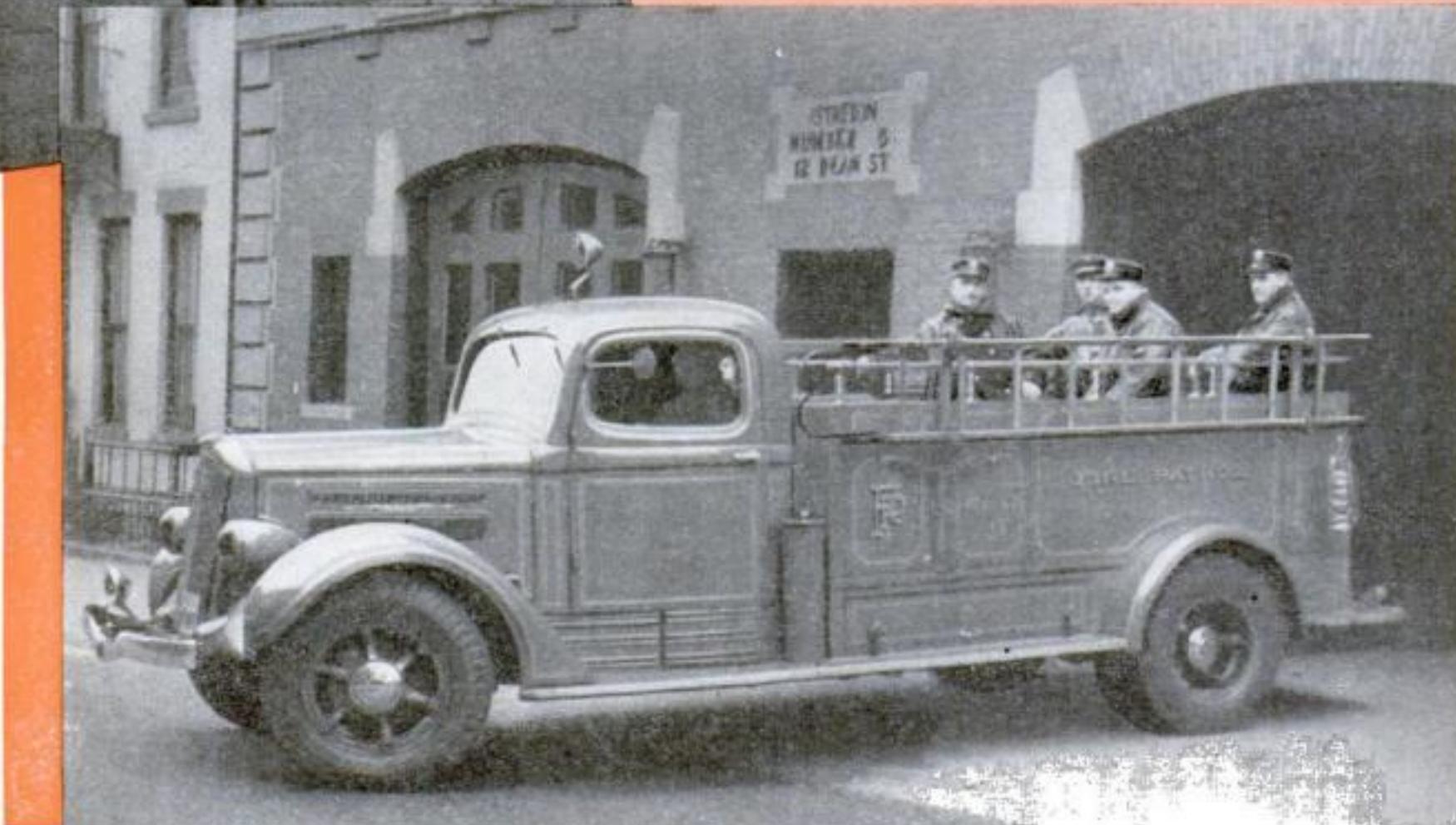
CLANG-CLANG-CLANG! A fire-alarm gong rings in an upper floor of a New York City building. Rubber-coated, leather-helmeted firemen carrying crowbars, emergency lights, and heavy tarpaulins rush onto an improvised stage decked out with painted scenery "flats" representing the walls of a two-room apartment. Responding with lightning speed to commands from hidden loudspeakers, the men move furniture to the center of the rooms, pile small articles on it, and cover the whole swiftly with waterproof covers.

Suggesting a rehearsal for an old-time movie melodrama, this little act is really a classroom lesson in one of the strangest schools in the country. In this school, maintained by the New York Board of Fire Underwriters, the 235 officers and men of the New York Fire Patrol learn by scientific theory and hard practice to protect property against the ravages of smoke and water—elements in modern fire fighting often far more destructive than fire itself.

Founded more than 100 years ago to track down fires at night, the New York Fire Patrol is now one of the most efficient salvage organizations in the world. Sponsored by insurance companies to help reduce property losses, its modern high-powered

By KENNETH M. SWEZEY

A member of the fire patrol slides down the pole as the alarm rings. Below, one of the sixteen "wagons"



Fires

PATROL

fire "wagons" race to all fires neck-and-neck with the equipment of New York's regular fire department. While city firemen pour water and chemicals on the blaze, fire patrolmen rush through lower floors, covering furniture, merchandise, and machinery, chuting water down stairways and out windows to prevent collapse of floors and damage to property.

Often they fight small fires themselves with chemical extinguishers, and wherever possible they join with police and fire departments in saving lives and rendering first aid.

Today, the New York Fire Patrol maintains eight stations and sixteen trucks. In 1938 its apparatus raced 80,000 miles, to 21,000 fires. At these fires patrolmen covered nearly 150 acres of valuable property with waterproof tarpaulins.

Besides teaching the men of its own organization, the Fire Patrol School has given special salvage courses to hundreds of volunteer and municipal fire fighters from all over the country. Capt. William S. Cashman, salvage expert and veteran fire patrolman, is in charge.

With fire raging in a building, there is little time for quiet deliberation. The school officers therefore try to foresee every emergency and train their men to handle these situations upon sight. Apartment houses, loft buildings, factories, stores, are considered individually. Full-size "sets" are erected in the schoolroom and stocked with the usual furnishings. In each case, patrolmen learn to save the maximum amount of property with the greatest speed.

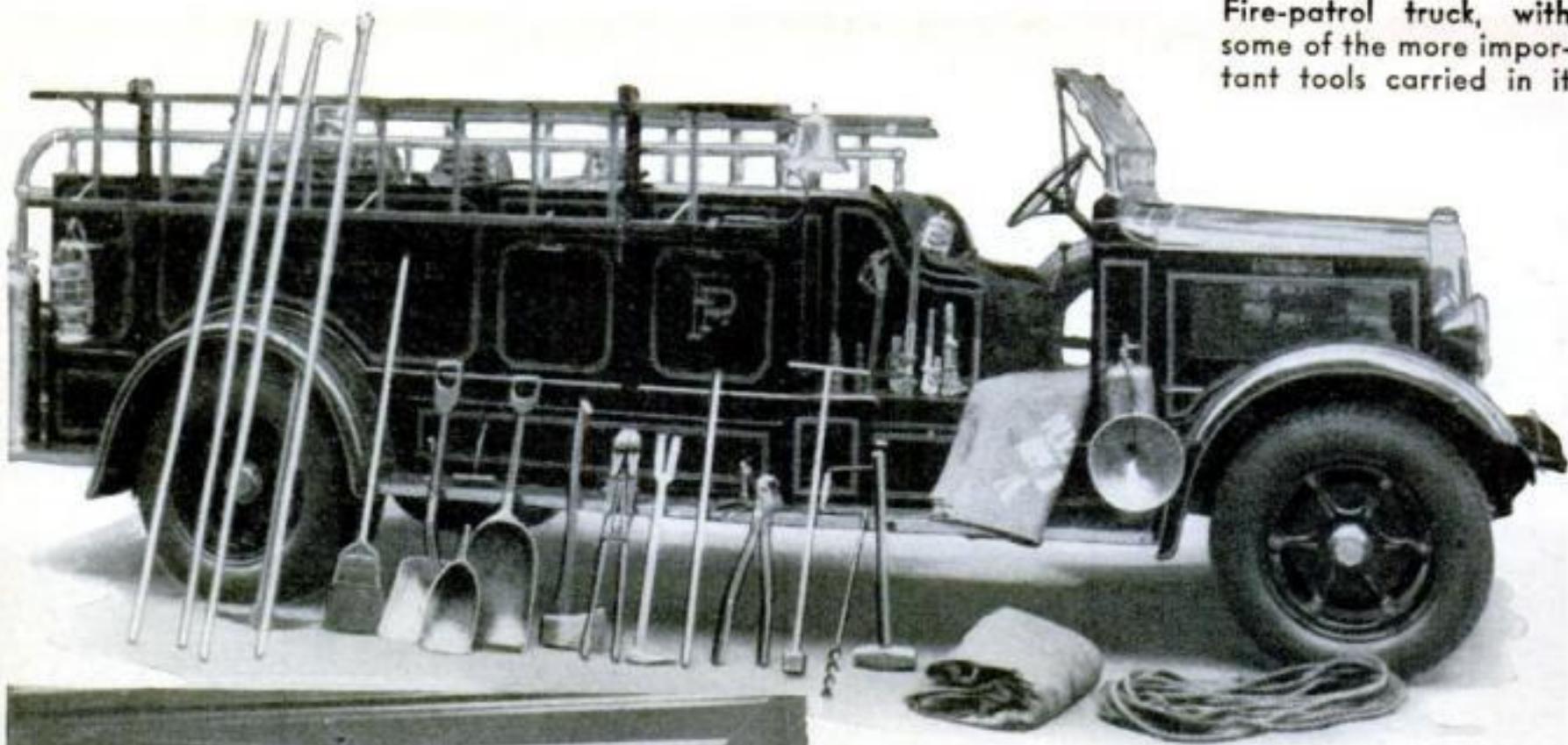
The chief weapon of the fire patrolman is a stout tarpaulin of waterproofed canvas. These "covers" measure twelve by eighteen feet and weigh between twenty-five and thirty pounds. Each patrol "wagon," or



Rehearsing for a fire at the patrol's novel school. On a "movie set" resembling a living room, men are taught to cover furniture and floors for protection against damage

truck, carries forty covers. Manipulating these covers under all conditions is not as simple as it seems, and much of the school curriculum is given to cover technique.

Fire breaks out in an upper story of an apartment house, for instance. As firemen pour water on the blaze, fire patrolmen rush into the apartment below to save furniture and other valuables from possible damage from water leaking through the floor. If other rooms are not in special danger, the living room comes first. Furniture is quickly moved to the center of the room. If there is a piano, or other piece of furniture with fine

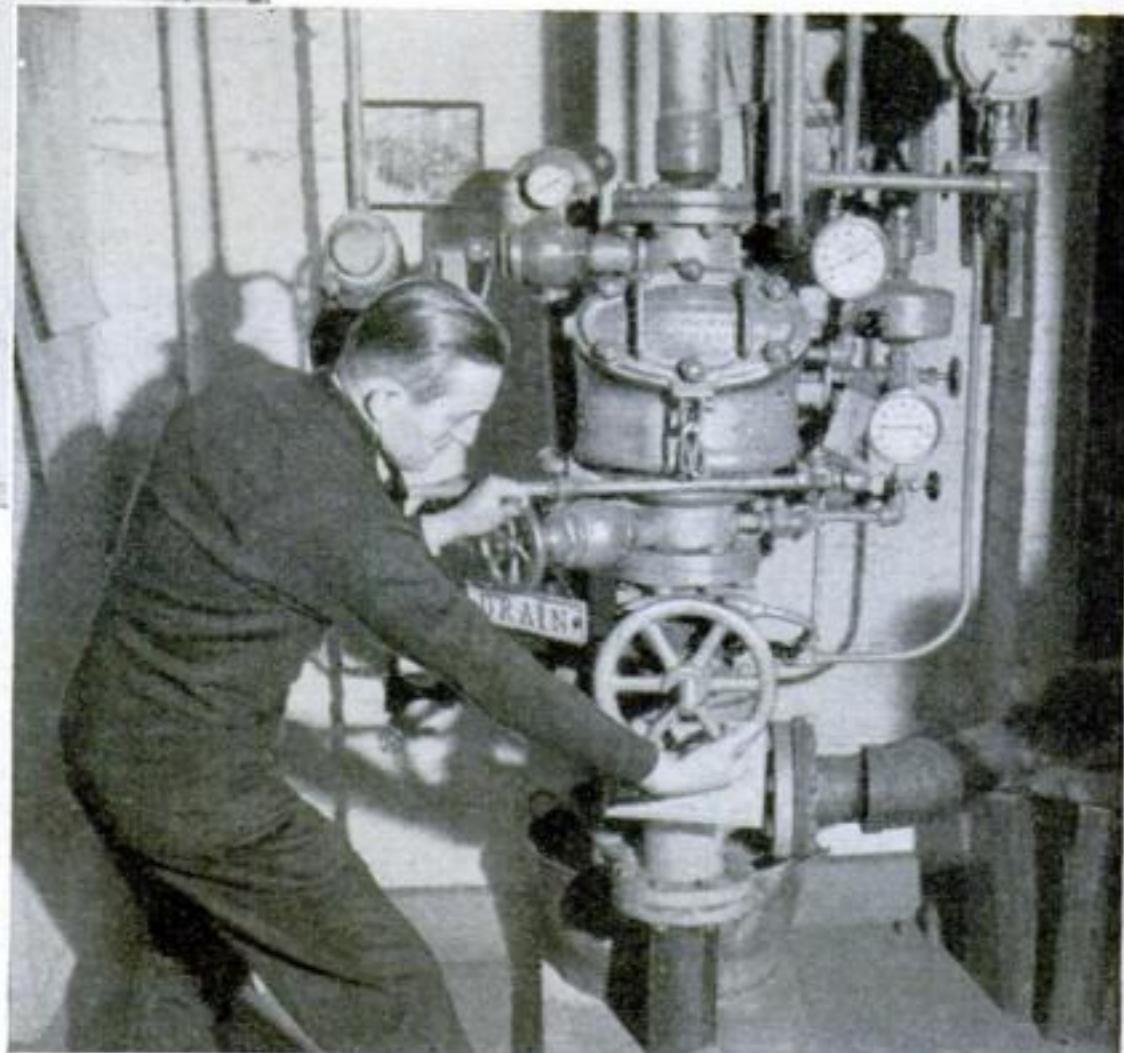


Fire-patrol truck, with some of the more important tools carried in it



Plugging an automatic sprinkler. Salvage men practice this wet job on two complete systems installed at the school

Another way to save property from damage by sprinklers is to shut off the main valve of the system, as at right



finish, a rug is first thrown over it, pile down. Small articles are put in table and bureau drawers. Tall, pointed objects, such as bridge lamps and coat racks, are laid on their sides so that they will not puncture covers if a ceiling should fall.

When everything has been carefully arranged, covers are thrown over the furniture. They must be thrown, and not dragged, to avoid causing scratches. They must also be laid so that water falling on them will drain off and not collect in heavy pools on top. Covers are then spread on the floor, with edges rolled to form sides of a channel which guides the water

where it can be disposed of most harmlessly.

Water coming through a ceiling generally starts through the hole around a central lighting fixture. If the leakage is light, the patrolmen catch it in buckets and throw it down a drain. If it is heavy, channels are made of covers and the water chuted down a stairway or out a window, or sometimes a hole is cut through the floor or wall.

In buildings where goods are piled high on shelves, the technique is different. Covering begins from the bottom up. While two men throw covers over the lower merchandise, two more climb to the next tier with their covers. Then the first men scramble above the second, and so on.

Removing covers, after a fire is over, requires as careful a technique as covering. Before covers are taken off, as much water as possible is removed with brooms, mops, and wooden shovels. The covers must be carefully lifted off so that they do not spill any of the

remaining water, or scratch the furniture.

For possible emergencies, patrolmen are taught to use covers as stretchers, to cover holes in roofs, as protection from rain, and to protect show windows from weather and intruders when plate glass has been broken. And the story is told how a cover was once used as a life net, saving the lives of a mother and child who jumped from the fifth floor of a burning building.



A patrolman practicing the use of a bolt cutter to break the lock of a door. Below, drill in protecting goods stored on shelves. Teams of men work upward from bottom tiers





Hoop Replaces Badminton Net

SHUTTLECOCKS must be hit through a mid-court wire ring, instead of over a net, in a novel form of badminton worked out by C. N. Boroughs, of Atlanta, Ga. Players stay within their respective playing courts, which measure nine by twelve feet, and stroke the badminton bird through the center ring into the opposing court. Rules of service and scoring are the same as those in the standard game.



When the hat is put on, its electric light shines

Bed Tongs Retrieve Objects from Floor

INVALIDS, or others confined to their beds, find it easy to retrieve objects dropped on the floor with the aid of the wooden bed tongs pictured below. About three feet long, the tongs resemble and operate like an elongated pair of shears. The tong tips are fitted with small rubber pads to prevent objects from slipping out of their grip after they have been grasped properly.



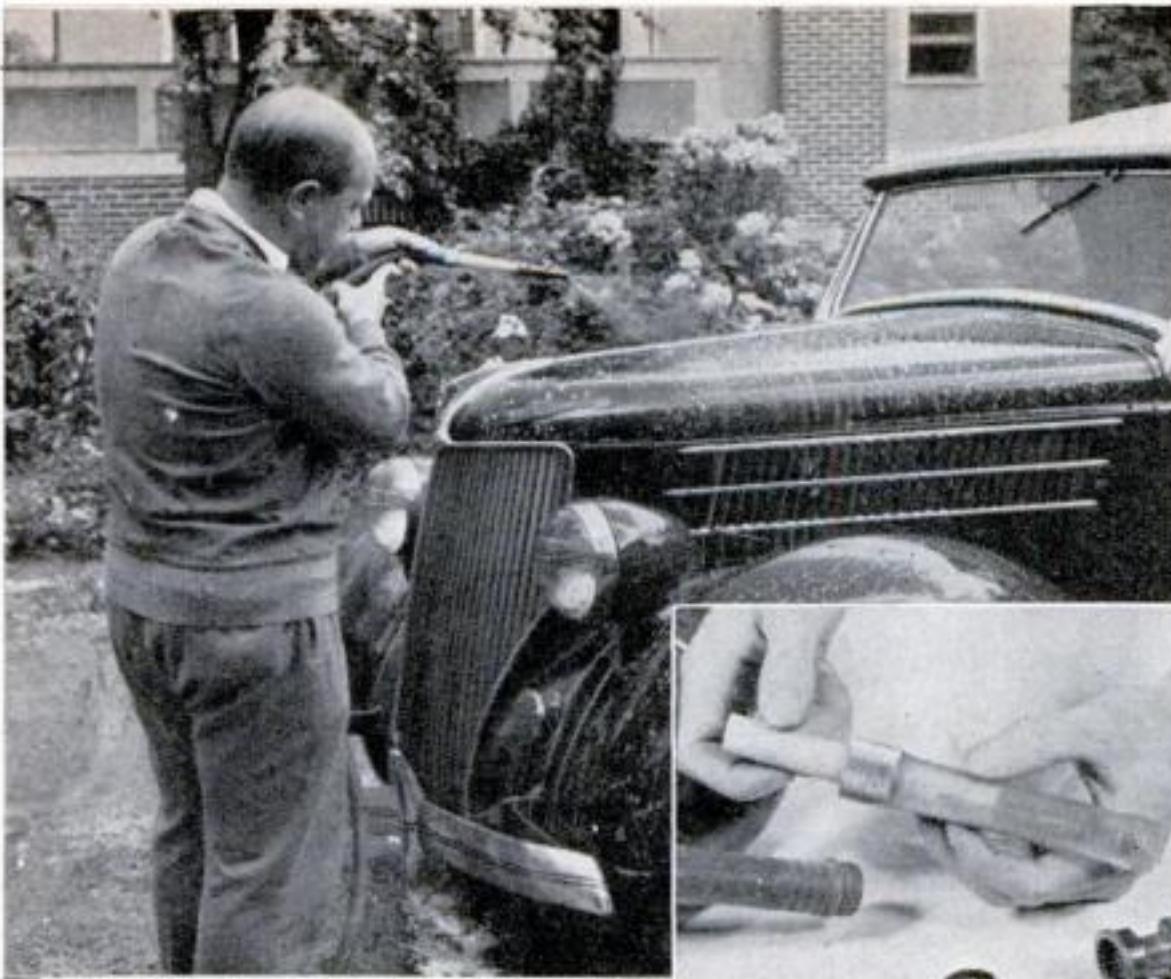
Light in weight and a yard long, the bed tongs are grasped by the scissors grips

Toy Miner's Lamp in Hat

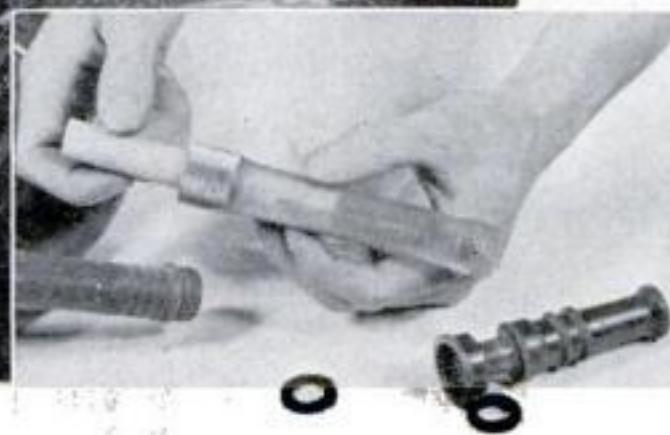
A CHILDREN'S version of a miner's hat lamp, recently introduced, is made of cardboard and includes batteries and a light bulb that turns on when the hat is put on and off when it is removed.

Shoulder Safety Straps

SHOULDER straps developed by the U. S. Army Air Corps for use with regular safety belts are designed to prevent head and neck injuries to pilots by preventing their heads from bumping against the plane's instrument panel when a crack-up occurs.



A soap cartridge placed in the nozzle, right, speeds a car-washing job

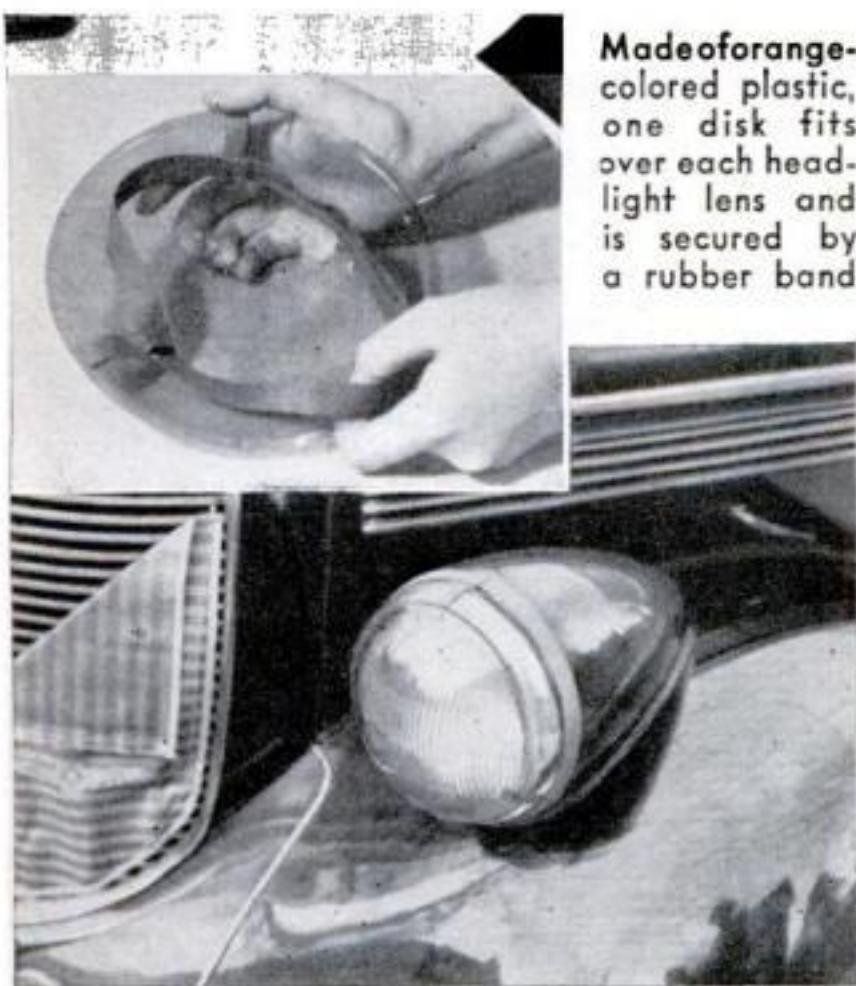


Hose Nozzle Is Soap-Spray Gun

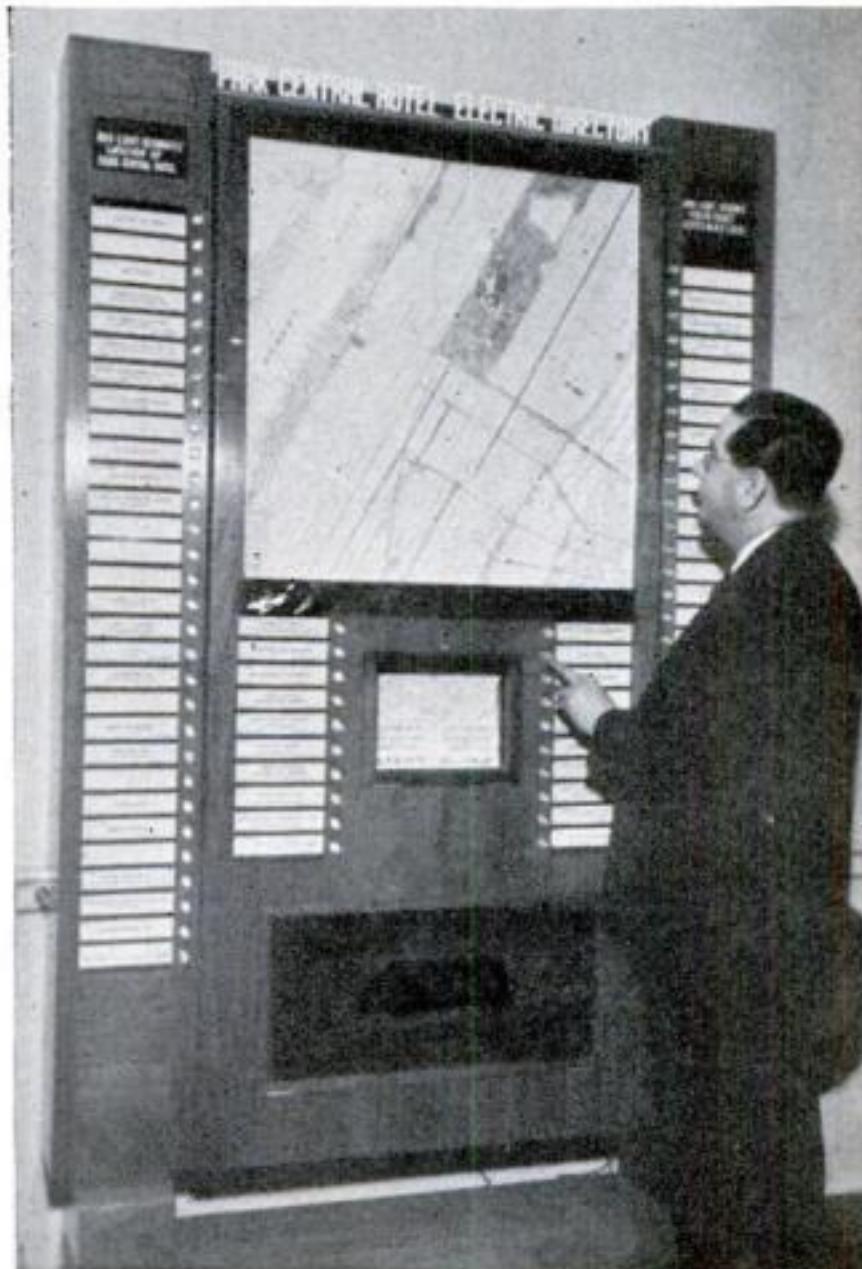
AUTOMOBILES are washed with a minimum of time and effort with the aid of a new water-hose attachment. Replacing the regular hose nozzle, the new unit incorporates a special soap cartridge producing a grease-dissolving, grit-removing spray. Trained on a car, the spray loosens dirt and grime, while a following rinse with clear water completes the washing job. Refill soap cartridges can be bought as needed.

Shields Make Fog Lights of Any Car's Headlamps

FOR driving in fog, an orange-tinted plastic shell just developed slips over the lens of an automobile headlight and is held in place by elastic rubber bands. It is claimed that the tinted shields increase visibility when driving through fog, because the colored light they give off does not produce the glare created when white light is reflected by the droplets of water that form a mist.



Made of orange-colored plastic, one disk fits over each headlight lens and is secured by a rubber band



Novel Electric Guide Map

PRESSING a button illuminates the site of a selected point of interest on a novel electric map guide set up for the convenience of out-of-town visitors at a large New York City hotel.

Puppet Show Drives Home Driving Rules



"Backstage" in the traveling puppet show, built on the chassis of the truck shown in the photo at left

A TRAVELING marionette show, mounted on a truck chassis, has been put to use by a large oil company in a national campaign against reckless driving. The villain

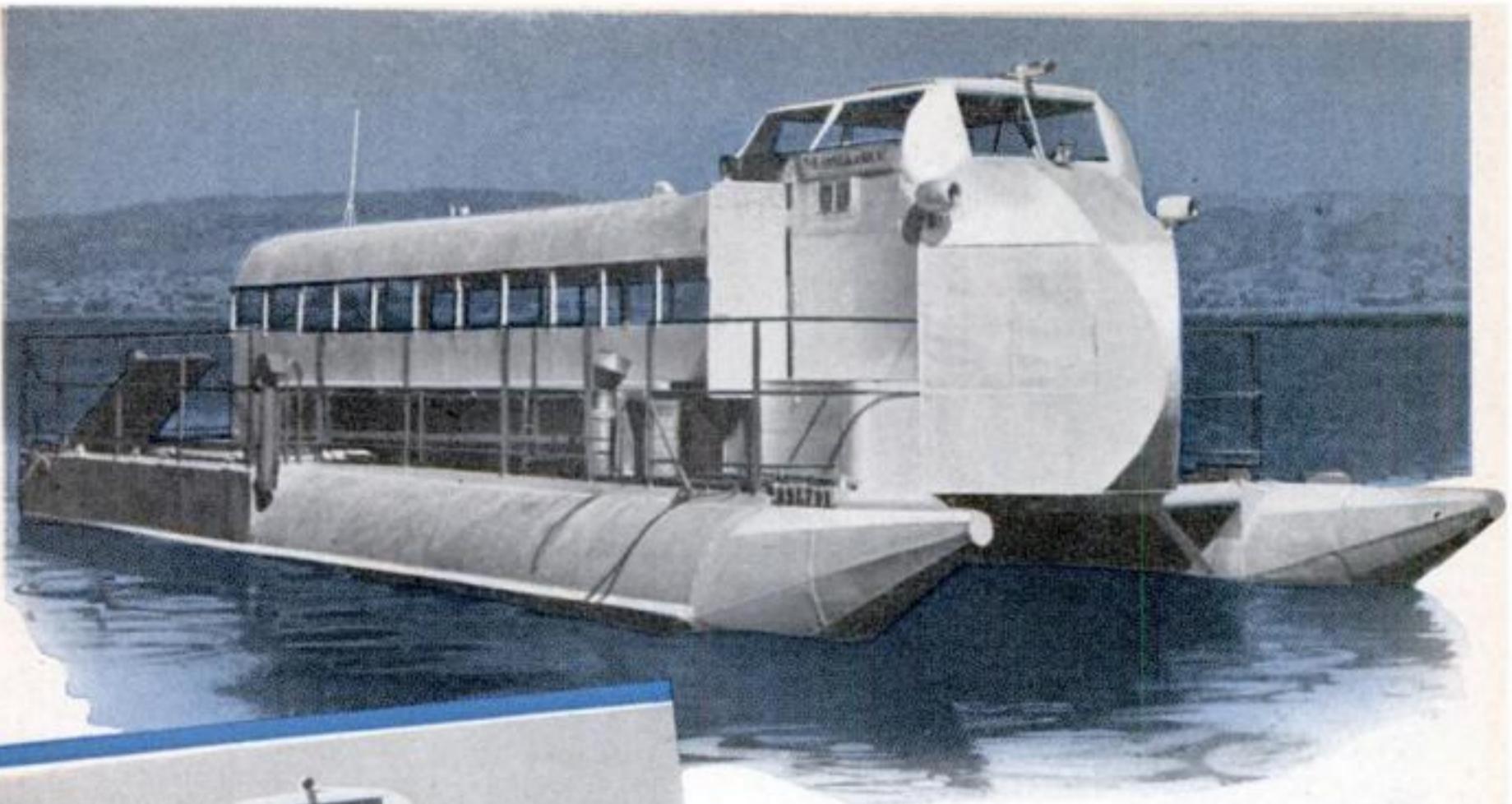
of its cast, a confirmed breaker of traffic rules, demonstrates with a miniature car how eccentric driving will snarl traffic and set the stage for serious accidents. He receives a verbal dressing-down from a policeman, who impresses the rules of safe driving upon the audience. Voices for the marionettes are brought to the audience by means of twin loudspeakers.

Novel Belt "Breathes" To Give New Comfort

MEN'S belts that "breathe," expanding and contracting as their wearers inhale and exhale, are declared to offer added comfort. Instead of being fastened so that it will not give, the buckle is anchored to the belt by a pair of small coil springs, and these provide the proper amount of play. The buckle fastening is seen at right.



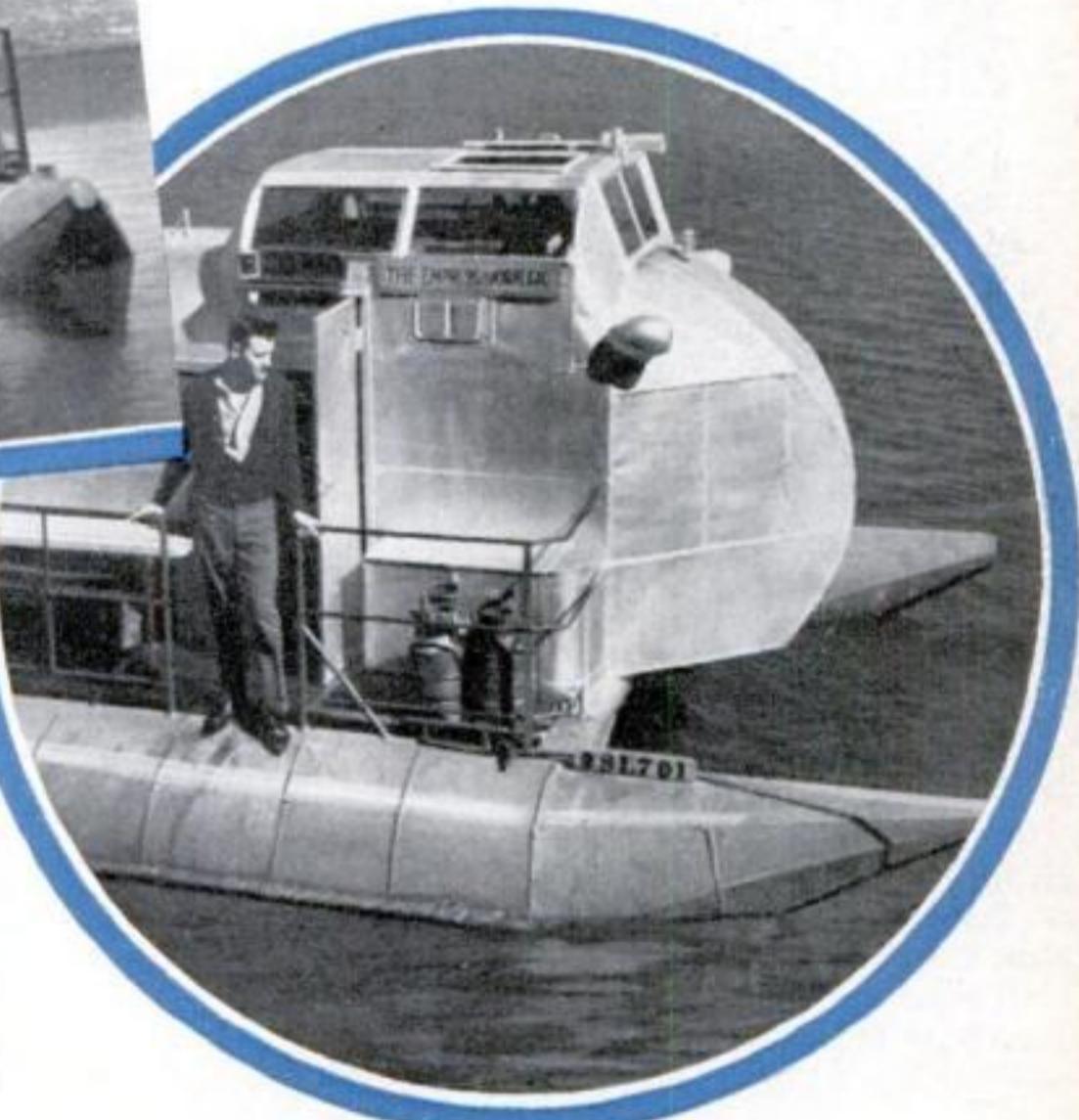
How the buckle is fastened to the belt with coil springs



Looking like a bus on skates, this novel craft was designed for carrying parties of anglers



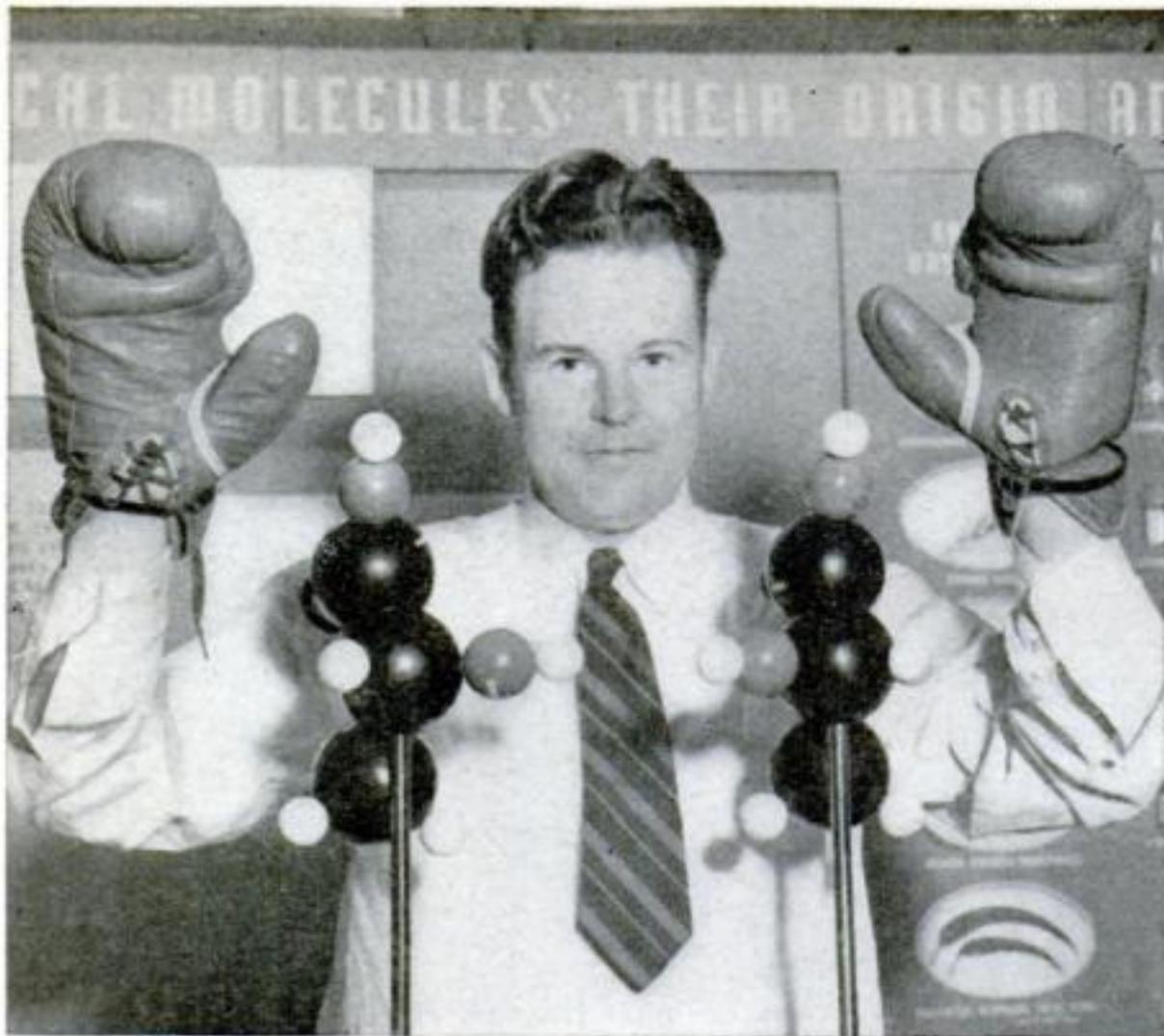
Nose-on view of the pontoon boat.
Right, note railing on the float



Pontoons Support Odd Fishing Boat

PONTOONS made of welded sections of steel float a unique boat constructed by students in an Oakland, Calif., school of welding for use as a fishing craft for large parties of anglers on San Francisco Bay. Powered by two 110-horsepower gasoline engines, one installed in the stern section of each pontoon, the odd boat will have a speed of about twenty knots. The supporting pontoons, each thirty-nine feet long and with a

twelve-foot circumference, are made in fourteen separate air-tight compartments, and are joined together by a welded truss made of six-inch pipe. Behind a raised, inclosed control bridge, the coachlike weatherproof cabin has accommodations for thirty passengers, who are able to fish from a rail-protected deck over the pontoons. Three views of the unusual craft are given in the photographs reproduced above.



Molecules May Be "Left-Handed"

WITH the thumbs of boxing gloves, Dr. H. H. Strain, of the Carnegie Institution, Washington, D. C., illustrates in the photograph above the fact that molecules can be either left or right-handed, a peculiar property being explored in current studies. A fly, used to food containing only right-handed molecules, would starve if fed only the southpaw variety which, it is stated, would be profoundly different. Polarized light reveals molecular left or right-handedness.

Camera Gets Movies of Fiery Furnace

PHOTOGRAPHING the interior of a fiery furnace to determine combustion efficiency is now made practicable by a novel apparatus designed by Fred Davidson, director of research of the New York Edison Co., of New York City. The unit consists of a long water-cooled tube fitted with two quartz windows at one end. As pictured at the right, a camera, designed to take either high-speed motion pictures or still shots, is mounted on a tripod and aimed at a window in the furnace. Between the camera lens and the furnace window, the water-cooled tube is placed to protect the optical system of the camera from the extreme heat of the furnace fire. By using various filters and film, Davidson has obtained useful data on furnace operation.



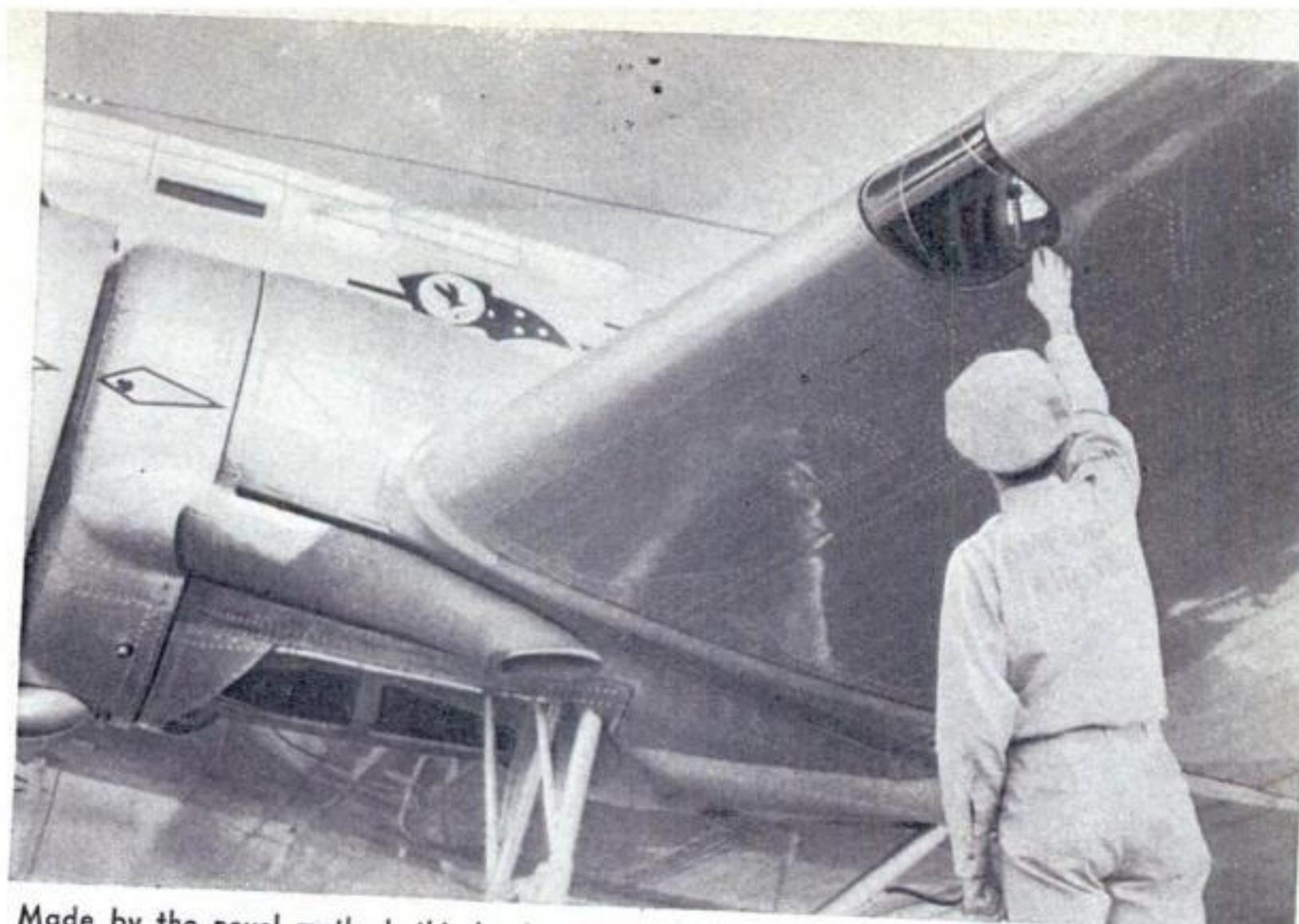
A quartz-windowed, water-cooled tube shields the camera lens

Tobacco Pouch Snaps Shut by Itself

WHEN pulled open by means of two leather tabs, the mouth of a tobacco pouch recently developed remains wide open while the user fills his pipe, and then, in response to slight pressure with one hand, snaps shut to make an airtight seal. Flat strips of springy metal that line the pouch opening do the trick. When the pouch is closed, loose tobacco cannot spill out into the pocket.

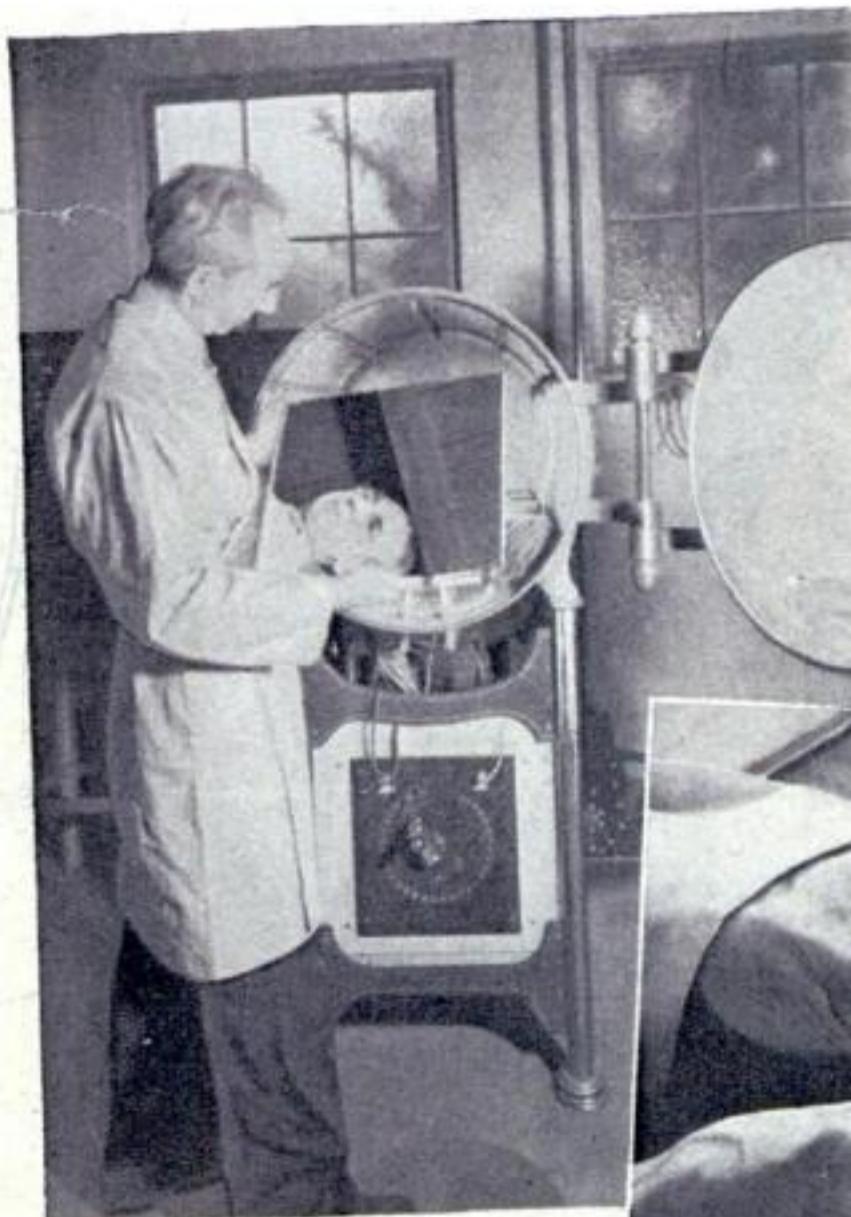


Opened by leather tabs, this pouch shuts at a light squeeze



Made by the novel method, this landing-light reflector is tarnishproof and of high efficiency

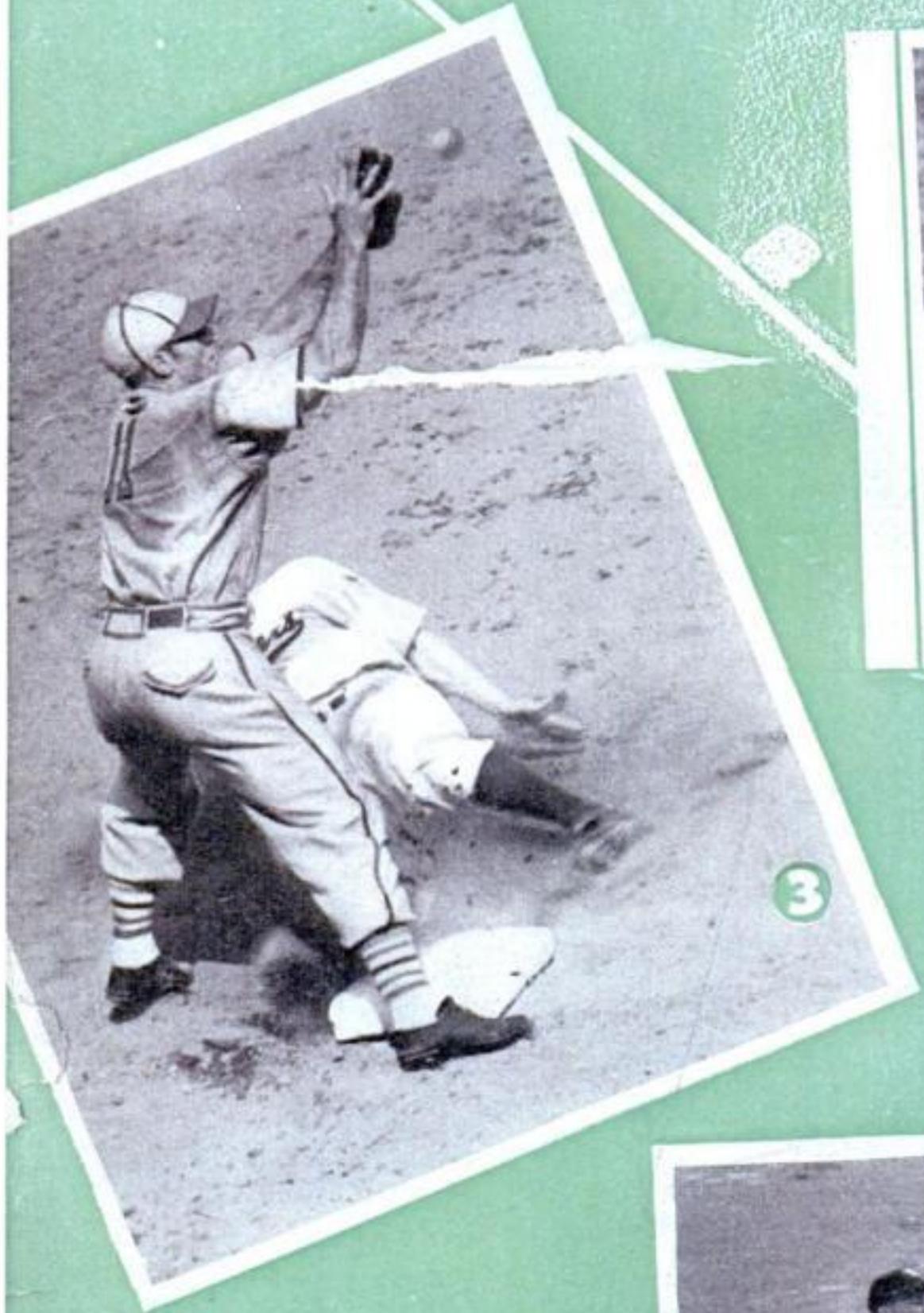
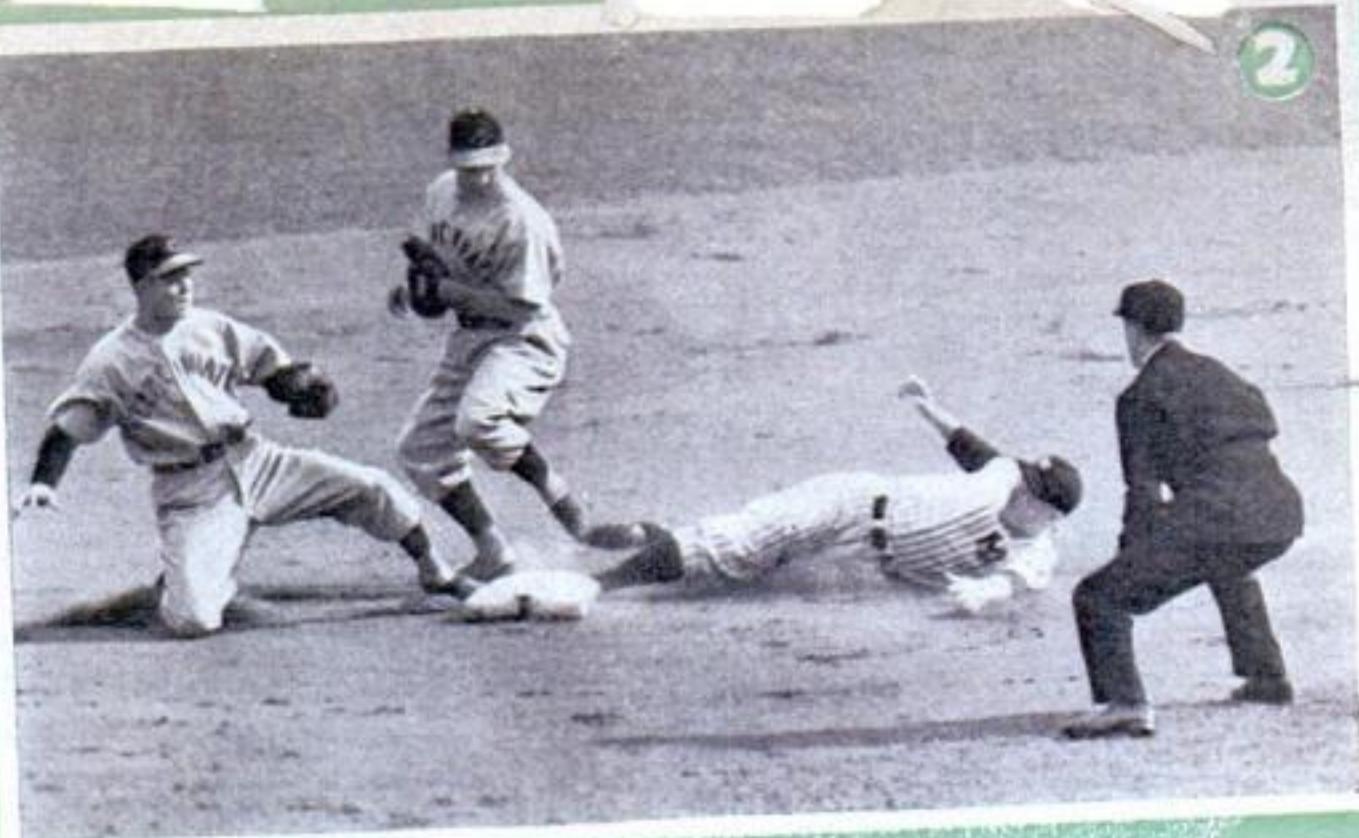
Vacuum Process Gives Better Mirrors



DEPOSITED electrically in a high vacuum onto practically any type of surface, a new metal-alloy coating for mirrors can be applied in minute thicknesses. Using this process, a California laboratory recently filled an order for 100 perfect mirrors, one twenty-fifth of an inch long and one fiftieth of an inch wide, on glass four thousandths of an inch thick. Packed separately in tiny glass capsules, the diminutive mirrors were made for use in movie sound recorders. Coating reflectors for airplane landing lights, and coating the surface of the giant 200-inch mirror of the Mt. Palomar, Calif., telescope, were other tasks handled by this process.

Inspecting glass just coated in the vacuum tank behind it. Right, tiny mirrors for use in sound recorders

cond base. Left
ght are second
nan, shortstop,
runner, and um-
Runner was on
and ran toward
nd when a batter
the ball toward
nd baseman, who
e for the bag. The
tstop ran to the
e to take a throw
cessary. Second
eman has ball. Is
runner safe? Or
e out? Take your
, then see page 233



Yaaaaah! Just a slight difference of opinion about a pitch which the umpire called a ball. Try your hand at these baseball puzzlers and you'll agree that a big-league umpire's job is no picnic

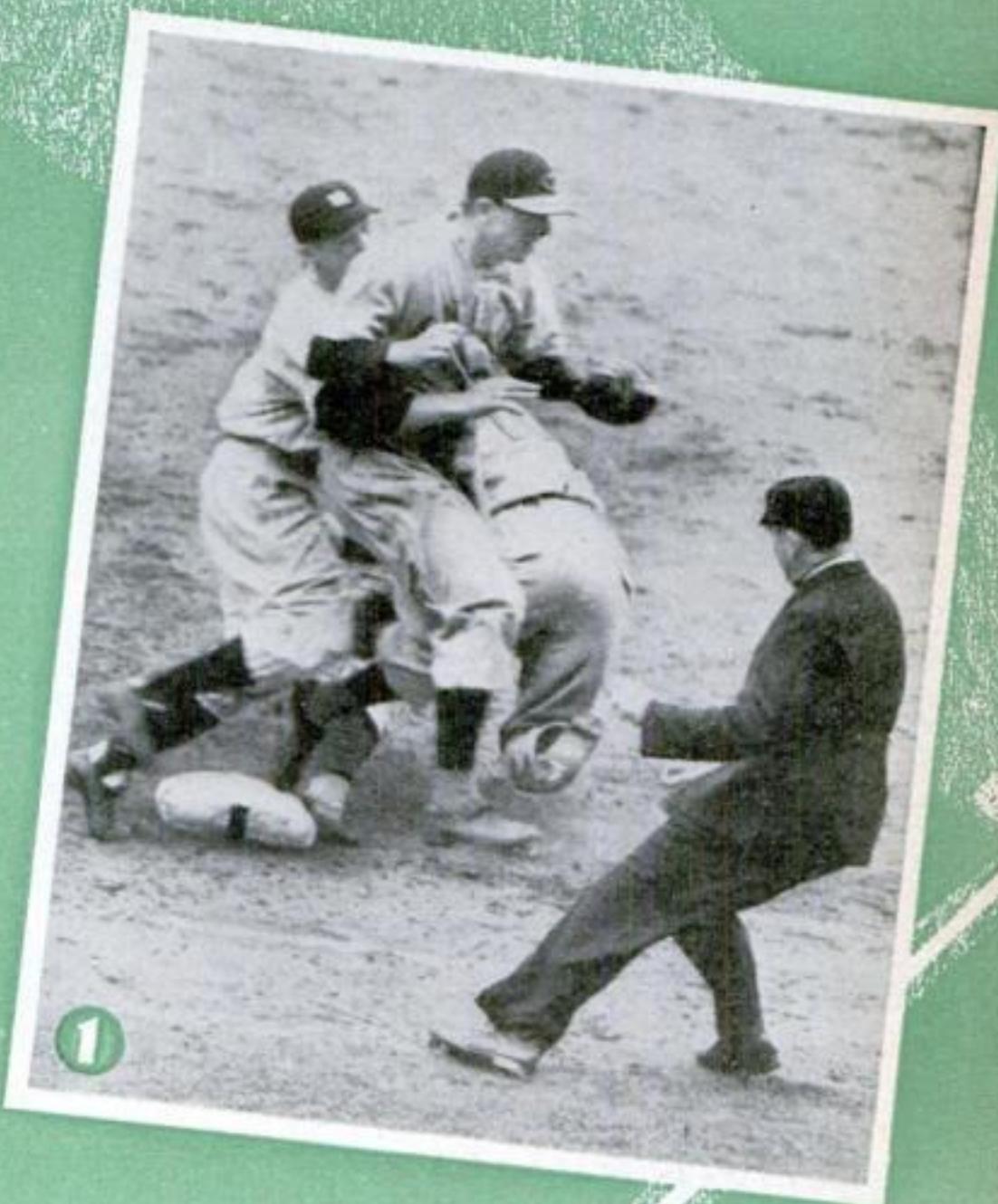
Another close one at third. The baseman has received a throw and is diving for the runner, who has overslid the bag



ying to steal third, the runner slides
word the bag while the baseman waits for
e ball, which can be seen in the air at
e right of the picture. Did the baseman
ave time to grab the ball and swoop down
tag the runner before he touched base?

Calling the Close Ones

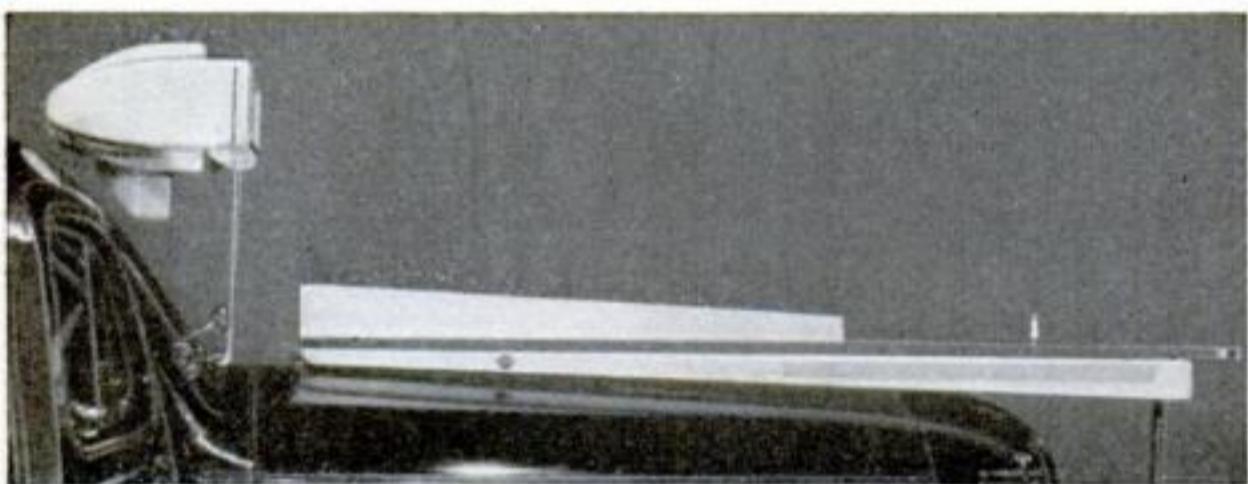
WHEN 30,000 throats bellow "Robber! Thief! Blind man!" from the stands at a baseball park, the fans can mean only one man: the umpire. But ninety-nine times out of 100, he's right, and the fans are wrong. Calling the close ones is his job, and if you think you can beat him at it, study the close decisions in the photographs on this page, call 'em as you see 'em, and turn to page 233 for the right answers.



Safe or out? In this mix-up at first base are, left to right, base runner, pitcher, first baseman, and umpire. The runner hit a ground ball to the first baseman, who fielded it and then ran to the bag, while the pitcher crossed from the mound



Action at the home plate, with a runner attempting to score. Did he? The ball is in the hand of the catcher, who is flipping it back to catch the sliding runner. It looks as though the latter will be safe, but will his right foot touch the plate before the ball can be pinned on him? answers on page 233



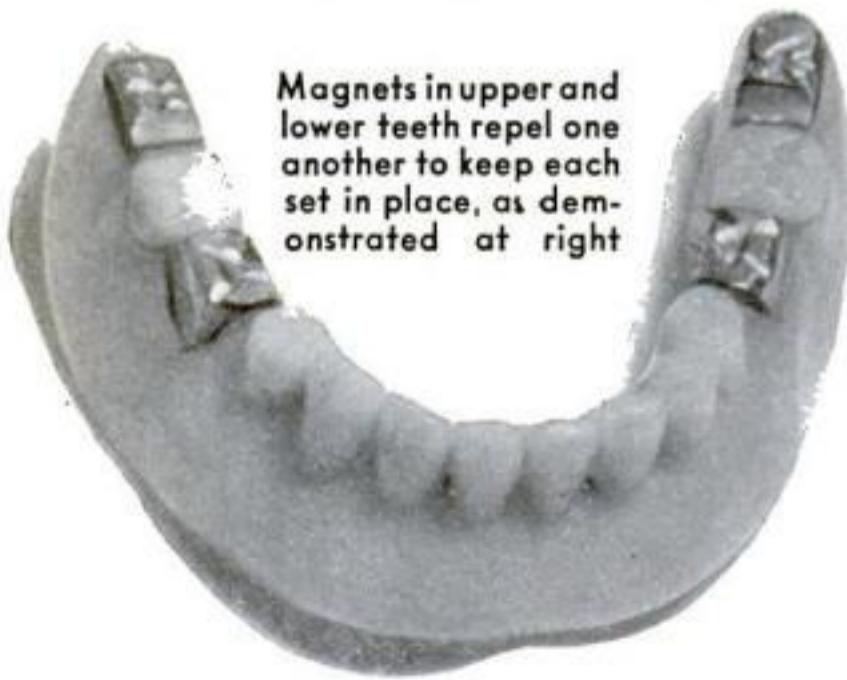
Pavement illumination, reflected glare, and direct glare under any type of street light are measured by apparatus on this test car

Street-Light Analyzer Is Mobile Unit

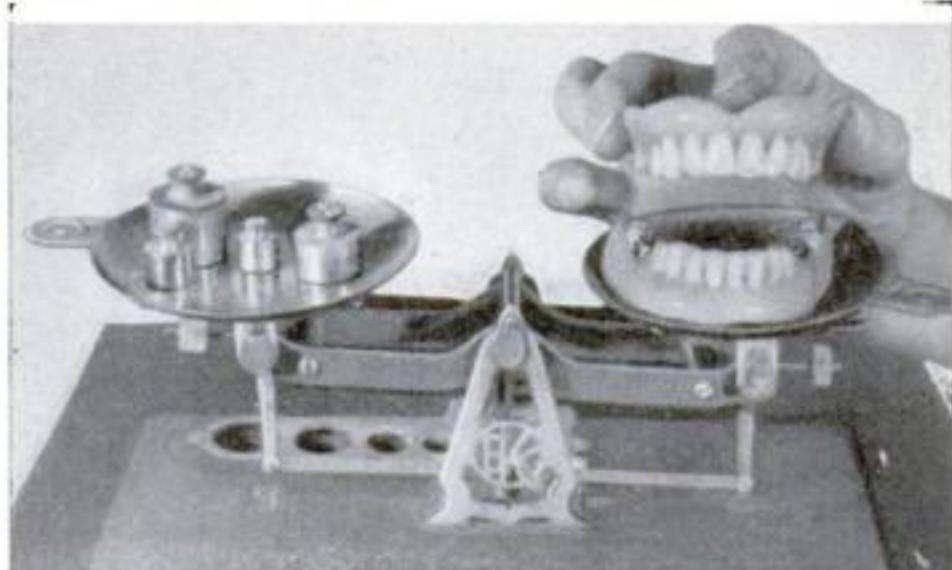
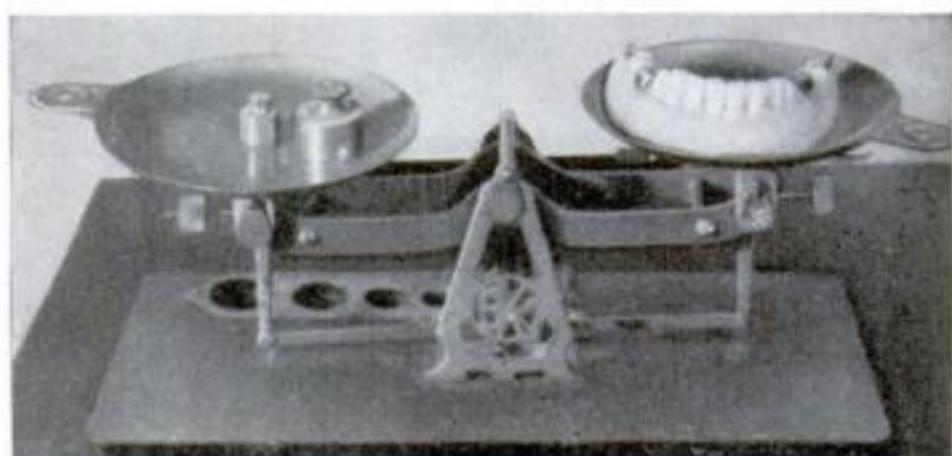
How effective are various types of street lighting? To answer this question, General Electric research engineers have devised an ingenious mobile "lighting evaluator." A miniature reproduction of the pavement surface of the lighted road being tested is mounted on the hood of an automobile, above the level of beams from headlights of approaching cars. Over the windshield is a glare collector that measures the total glare from street lamps within the driver's field of vision. Within the test car is an electrical instrument, adjusted and set by control dials and switches, that automatically records measurements of various lighting factors.

Magnets Hold False Teeth in Place

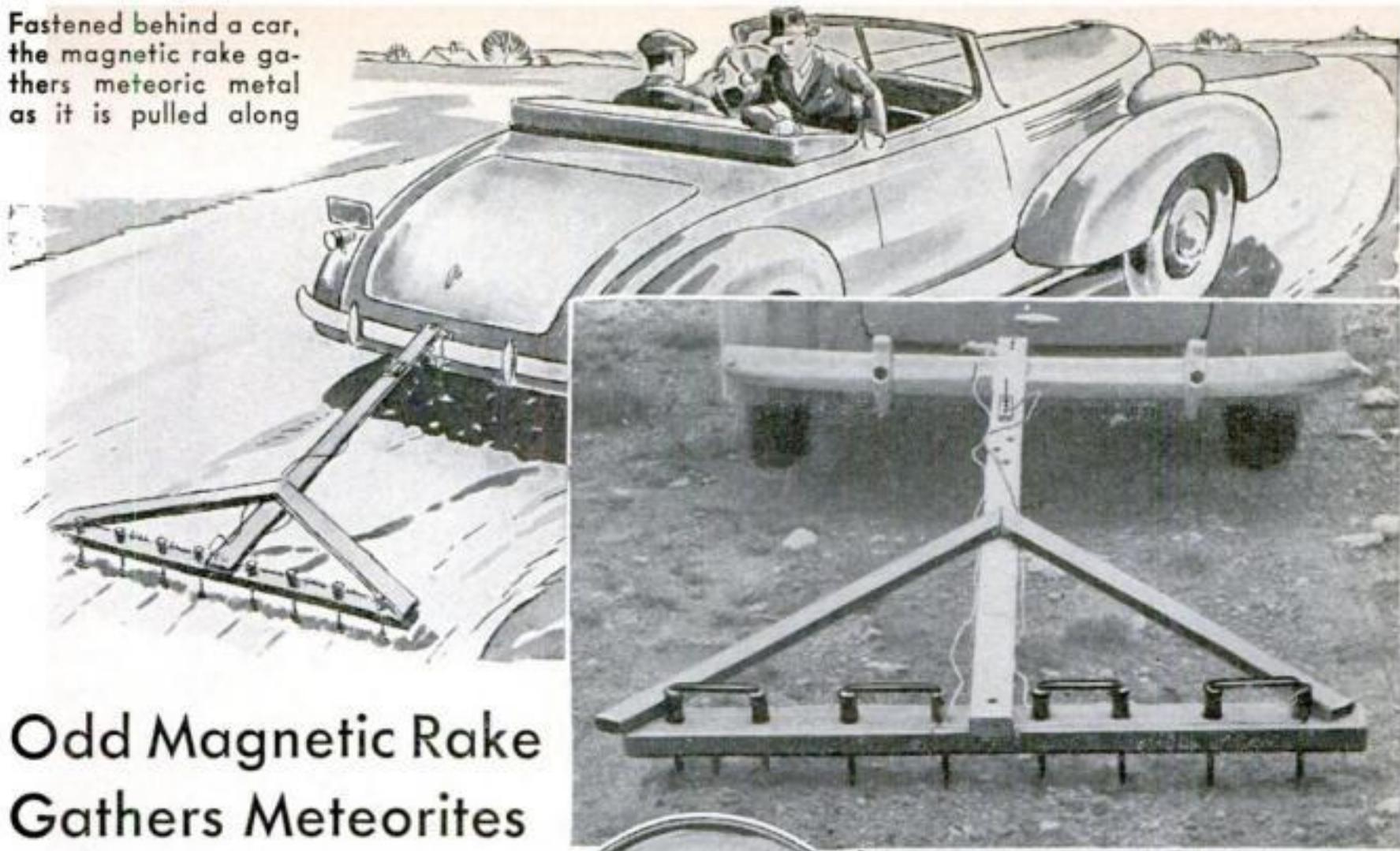
MAGNETS help to keep false teeth in place in the wearer's mouth, under a system devised by a New York City dentist. Placed near the back of each set and concealed by porcelain sheaths, the magnets in the upper plate repel those in the lower to steady the teeth in the mouth and keep them from falling out.



Magnets in upper and lower teeth repel one another to keep each set in place, as demonstrated at right

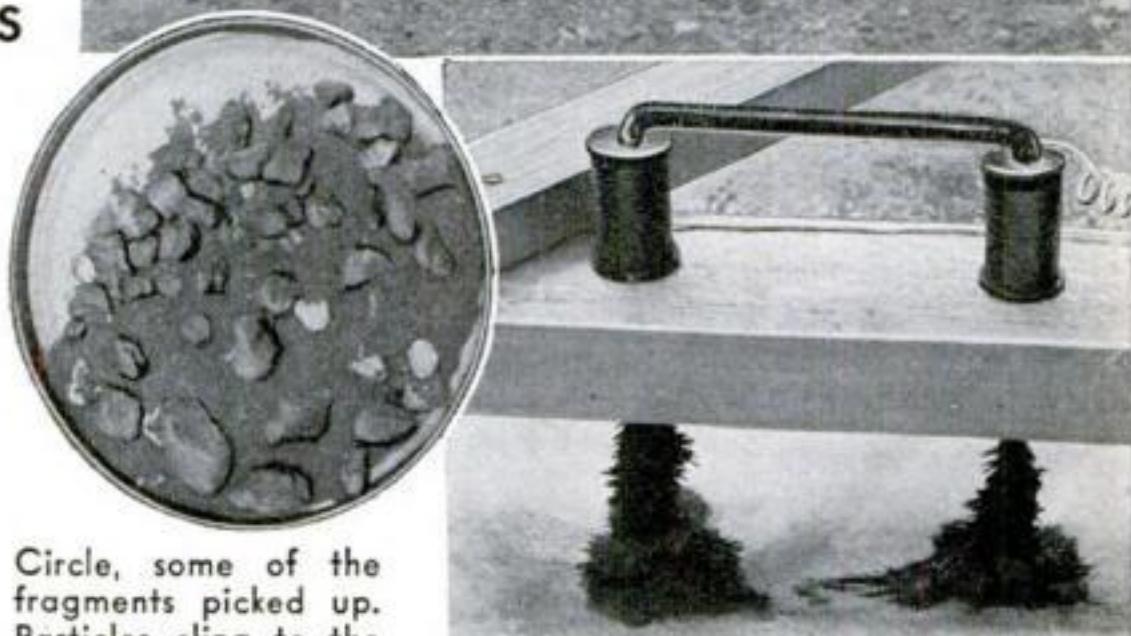


Fastened behind a car, the magnetic rake gathers meteoric metal as it is pulled along



Odd Magnetic Rake Gathers Meteorites

HARVESTING meteorites with a magnetic rake has recently been proved practical by two scientists of southern California. Towed behind a moving automobile, the rake employs four powerful U-shaped electromagnets energized by a storage battery. As it is drawn along the ground, meteoric fragments containing iron and nickel are attracted to the magnet poles and cling there, making their collection easy. In a tryout on the rim of Meteor Crater, Arizona, the device picked up pieces up to two inches in diameter, in addition to a quantity of meteoric dust. The specimens are frag-



Circle, some of the fragments picked up. Particles cling to the magnet poles at right

ments of the giant meteorite that blasted out the 600-foot-deep crater, nearly a mile in diameter, when it crashed to earth and exploded thousands of years ago. Since the huge pit was discovered in 1850, a number of shafts have been sunk in attempts, so far fruitless, to find the main body of the meteorite and exploit its mineral riches.

Toy Actors Strut Stage in "Mystery" Theater

IN A "mystery" toy theater, comic figures made of wood walk either forward or backward across the stage, without the benefit of winding or mechanism of any kind. The actors also perform as well outside the theater, on any inclined board, for the secret of their ability is that they move by gravity. Standing five and a half inches high, they are modeled and hand-painted to represent familiar comic-strip characters.



Placed on the stage, the figures walk by themselves

Foiling the Gold Thieves



Mines are watched with field glasses to see if they are blinds for traffic in "hot" gold

THEY called it a "dude" mine because every man underground had to wear safety-toed shoes and a hard hat. "Cold serum" shots were free for the asking, and the milling machinery was the latest and best.

A huge safe guarded the choice specimens of ore, the rich concentrates from the flotation machines. Armed guards patrolled the entrances, and an electric eye sounded warn-

ing of prowlers. There was even a "double-change" room where men coming up from work in the wet tunnels would hang up their muddy clothes; then walk, stark-naked, to the showers, where ultra-violet lamps would play on them as they bathed, giving them some of the sunshine they missed while working below. Then they walked to another room to put on their street clothes. It was impossible for them to carry away valuable ore in their clothing. But month after month, a good share of the mine's fabulously rich ore—some of it worth as much as \$160,000 a ton—was being stolen.

The owners summoned Inspector John Bongard of the California State Mining Bureau, who, in collaboration with Sheriff

By STERLING GLEASON



Gold is smuggled in shoes, pipes, and lunch pails as in the posed photo above





Miners avoid suspicion by leaving work clothes at mine. Top, armed guard, and right, guard at an entry gate with remote-control lock

George M. Smith, of El Dorado County, struck a trail that led them to a private residence, well screened from passers-by. Behind a woodpile they spotted a long trough, down which muddy water trickled. It came from an old shack, out of which boomed the tremendous thumping of ponderous gold crushers at work. Closing in, they trapped the leaders of the twelve-man ring of "high-graders" and learned the secret of their operations.

When a member of the ring found a choice bit of ore as he worked, he would cache it in the drift. In the early morning, while few men were on duty, one of the gang would be lowered down the shaft to grease the pumps. He would transfer the ore to the skip, bring it to the surface, and pass it to an accomplice who smuggled it through the gate in an automobile.

The head man milled and marketed the ore, paying a portion to his confederates. He also had a private racket to double-cross his partners. Ore passing from the crushers was flushed onward by running water. Part of this fluid was diverted to secret receptacles and processed for himself as an extra "cut."

This recent case from the files of the



Protection for ore en route to a smelter. Below, a bottle of gold amalgam worth a good many dollars



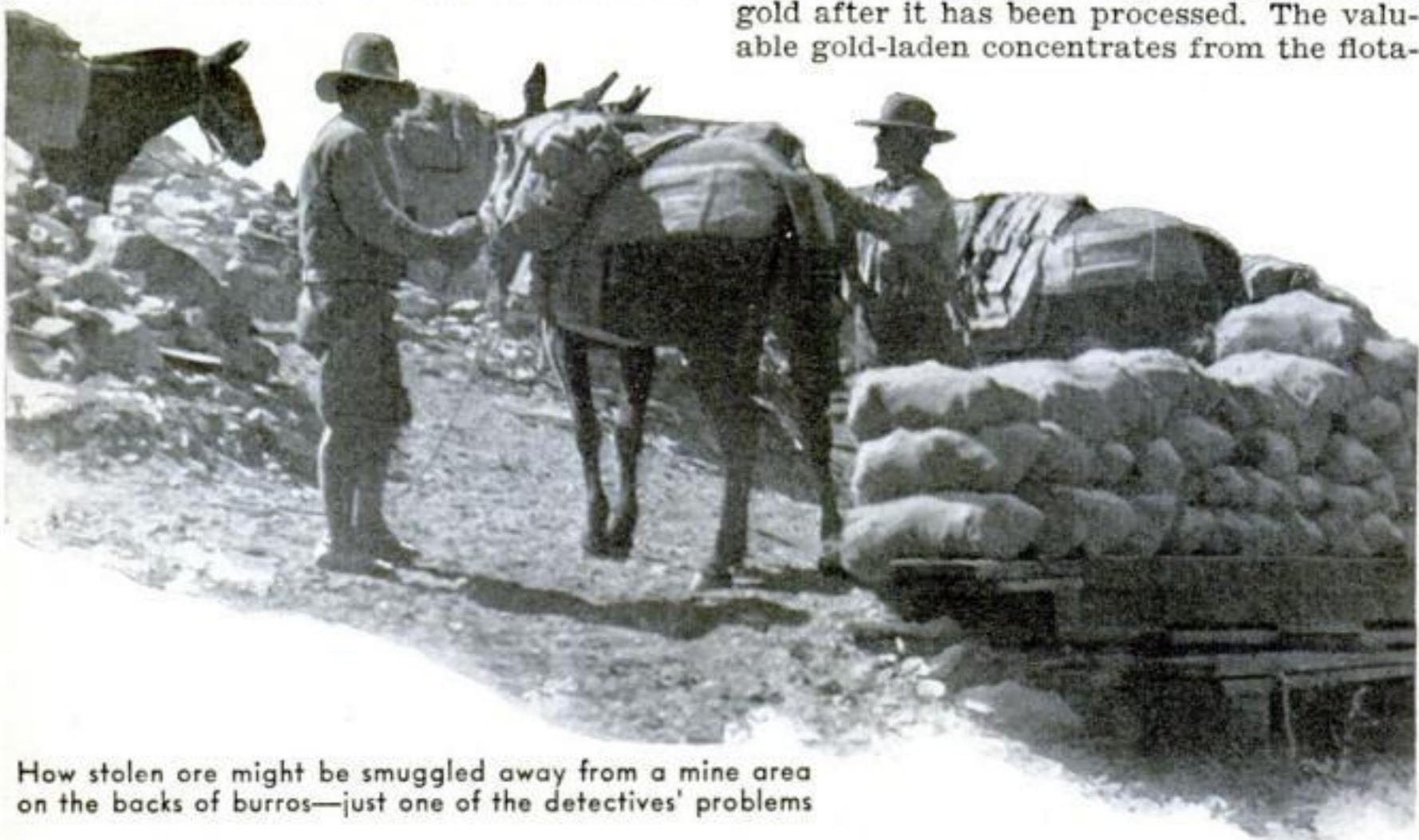
California Mining Bureau was the first in a drive to smash the amazing high-grading racket that annually milks the mining industry of millions of dollars. When I visited that office recently, officials were just closing a case in which they had caught a trio of gold thieves whose operations cost mine owners, in a tiny camp of only a few hundred people, more than \$100,000 a year.

So big are the returns from this traffic, that in some towns near important mines, a dozen assay offices may be thriving. Most of them, perhaps, are legitimate, but some actually are fences for the high-grader, and market the "hot" gold at a big profit.

Although most gold ore runs a few dollars to the ton, and is too bulky to carry off in lunch pails, some mines have occasional pockets of fabulous richness. One famous

California mine has yielded specimens nearly half pure gold—worth easily \$250,000 a ton. A miner can knock off the surplus quartz; then carry away the gold in his thermos bottle, in a tobacco tin with a false bottom, an empty watchcase, the heel of his pipe, the filling of a sandwich, or even his mouth.

Of course high-graders prefer to steal the gold after it has been processed. The valuable gold-laden concentrates from the flota-



How stolen ore might be smuggled away from a mine area on the backs of burros—just one of the detectives' problems

tion machines are always tempting. On the big floating dredges, too, thieves sometimes raid the washboard-like riffles, where, behind each corrugation, mercury lies in puddles to trap gold particles from the sandy mud passing down the trough.

The high-grade traffic flourished for years largely because it was hard to prove legally where the stolen gold came from. Moreover, lenient local juries seldom would convict a high-grader. Nearly \$2,000,000 a year was being stolen from large mines in California alone when the U. S. Secret Service detailed Capt. Thomas B. Foster and Charles B. Rich to work with Inspector John Bongard, ace of the California Bureau of Mines, in a campaign to smash this multimillion-dollar racket.

Events meanwhile had placed behind the double-edged drive the power of the Federal Government. In 1933, the country went off the gold standard, and all gold pieces were



Weighing a \$15,000 chunk of gold. Note wire guarding the scales

called in. So was all gold bullion—at the old price of \$20.67. But immediately the price of gold began to skyrocket. Soon it was worth almost double. Holders of gold naturally wanted to get \$35 an ounce if they could. Many of them wouldn't turn it in to the Mint.

So was passed (*Continued on page 235*)

Two ways of finding where gold ore comes from: Below, grinding it for chemical tests, and right, examining thin slices by microscope



An ore sample mounted on a slide for microscopic study



Yes, she's wearing glasses! At right, note the polished facets along the edges of lenses



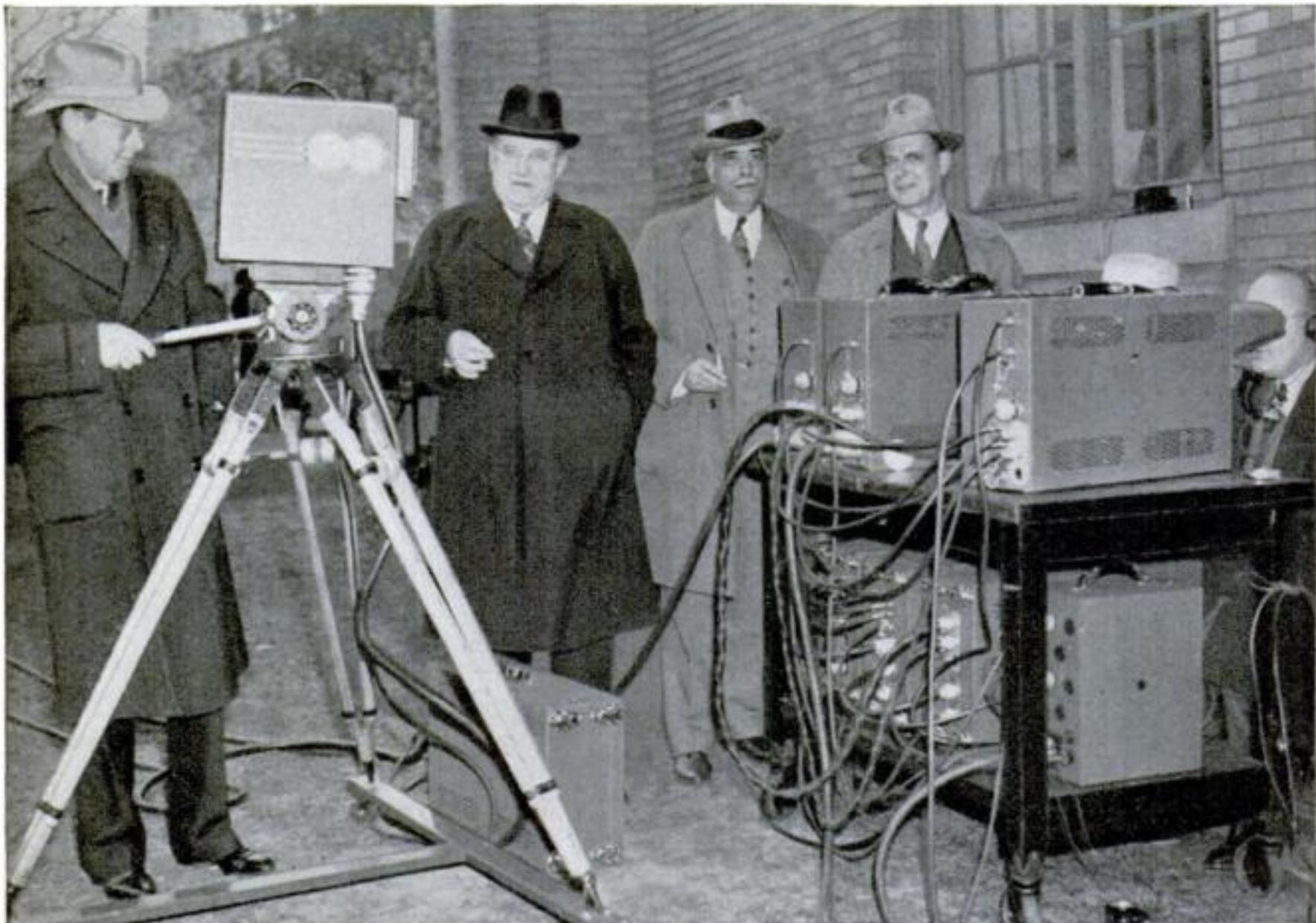
Light-Diffusing Lens Edges Make Eyeglasses Invisible

SPECTACLES with lenses that are practically invisible while being worn have just been made available. The effect is accomplished by means of polished facets on the lens edges, designed to diffuse and scatter the reflections of light striking them, thus making the lens edges difficult to see. Some types also have an inlay at the top of the lenses, designed to blend in with the eyebrow line.

"Suitcases" Hold Television Pick-Up

COMPACTNESS and portability are two of the outstanding features of a suitcase television transmitter designed and constructed recently by research engineers of the Radio Corporation of America. Developed as a substitute for mobile television equipment mounted in special trucks, the new outfit is planned for use in picking up programs at remote points for relay to central transmitting stations. The television camera used

resembles a studio motion-picture type, and is mounted on a collapsible tripod whose legs fit into a T-shaped base. Transmitting equipment is built into metal cases about the size of a suitcase and fitted with handles for ease in carrying. Various suitcase units are connected together by a network of plug-in cables to form the complete transmitting assembly. In the photograph below, the new transmitter is being demonstrated.



Portable television transmitter set up for action. Plug-in cables connect units housed in metal cases



V-shape lines mark buried cables of Navy's new blind-landing system at Lakehurst, N. J.



Magnetic needles on instrument panel guide a pilot to a landing

RAIN, fog, or other adverse weather conditions have no effect whatsoever on a new magnetic blind-landing system for airplanes, developed by U. S. Navy experts and installed not long ago at the Naval Air Station at Lakehurst, N. J. Bringing his ship in for a landing, a Navy pilot watches magnetic pointer needles on the face of a dial installed on the instrument panel. By handling his plane so that a vertical line on the dial is equidistant between the two needle pointers, the pilot is automatically guided to a safe landing. The magnetic system utilizes two 3,000-foot cables, laid out in a V and buried four feet beneath the surface of the airport. Alternating electric current flowing through these cables sets up a magnetic field that influences the needles in the instrument. The system is said to be effective for a distance of 9,000 feet.



The control panel, through which alternating current is fed to the buried cables to create the guiding magnetism

Everybody Rows

Amateur oarsmen lined up beside their shells at Marine Stadium, Long Beach, Calif. Below, a race between sixteen-oared barges manned by younger boys



This narrow inlet was the scene of rowing events for 1932 Olympic Games

LONG BEACH
RECREATION DEPARTMENT

at Novel Aquatic School

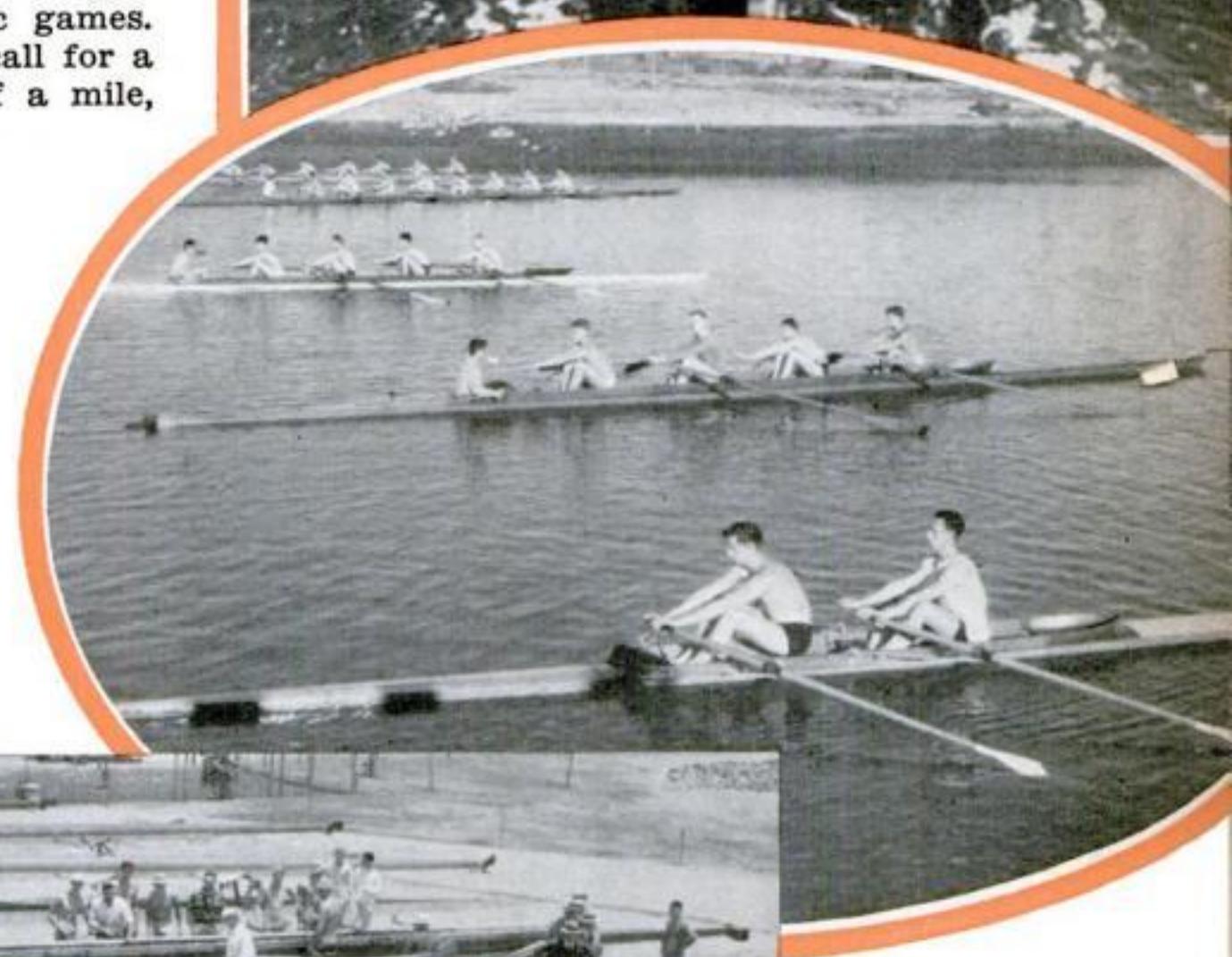
IN BOATS ranging from practice barges to famous racing shells, 750 amateur oarsmen bend to the oars each week in a training school maintained on Marine Stadium by the City of Long Beach, Calif. Six different groups practice on the narrow waterway, from boys of junior-high-school age to adults who row occasionally for pleasure.

This novel program started nine years ago when Frank M. Davenport, director of aquatic sports, borrowed five small boats from a near-by life-guard station and put crews in them. When the 1932 Olympic games closed, Davenport purchased three racing shells from the Japanese, and the Long Beach Rowing Club bought the German boats. The fleet now includes ten eight-oar shells, five four-oar racing and practice shells, and an assortment of whaleboats, work gigs, single racing shells, single sculls, and pair-oar racing shells.

Marine Stadium is an arm of the Pacific Ocean, and was developed especially for the Olympic games. Races for the youngsters call for a distance of five eighths of a mile, while the girls are not permitted to race. The program is intended to build muscle and teach safety.

By
**ANDREW R.
BOONE**

Each crew must take care of its own equipment. Below is a scene in the boat yard, as handlers go over the shells



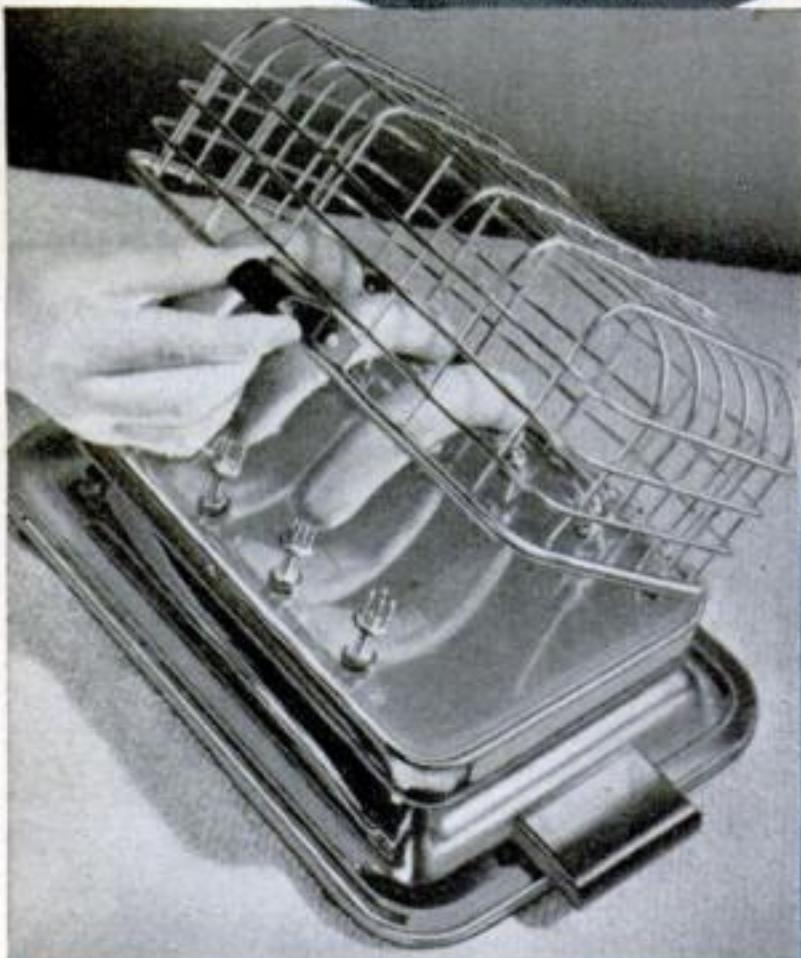
Five crews lined up for starting practice. At top, beginners bend to their oars in barges used for early training

Handy Helps



ELECTRIC BEAUTY CABINET

Electric appliances included in this boudoir cabinet are a hair curler, water heater, iron, drier, vibrator, clipper, razor, and radio



"HOT SEAT" FOR HOT DOGS
Frankfurters are electrocuted in the novel cooker illustrated above. Current flowing between forks cooks them



DEEP-FAT FRYING is made safe and pleasant by the pan below. It has an inner metal ring to prevent fat from boiling over, and a thermometer (left) that fits its edge

for Homemakers



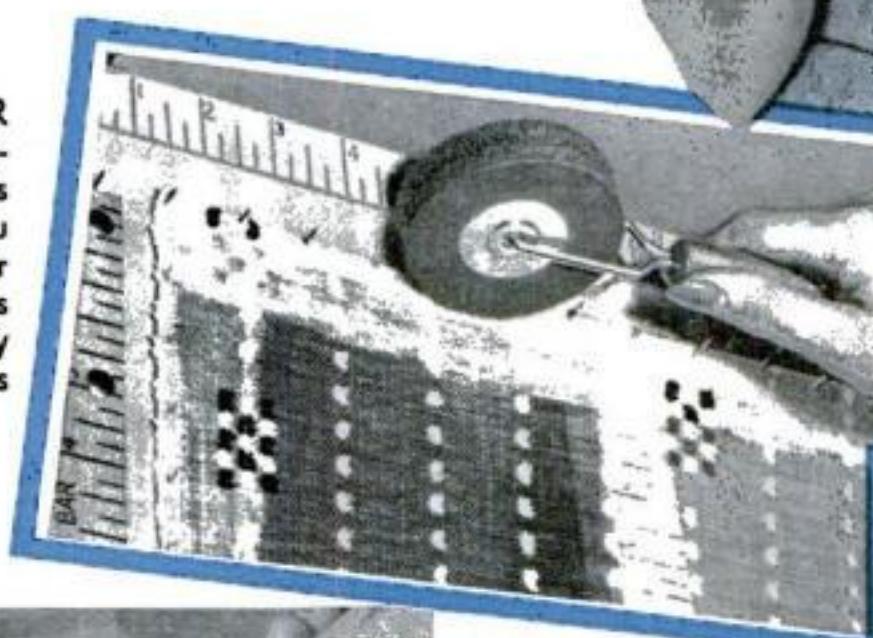
CANDLE KEEPS FOOD WARM. Foods to be kept warm are placed upon a perforated metal disk above a candle in this plastic container



GUTTERS ON RUBBER GLOVES. Bell-like cuffs on the rubber gloves at right are turned up to keep water from running down the arms

CURTAIN PINNER

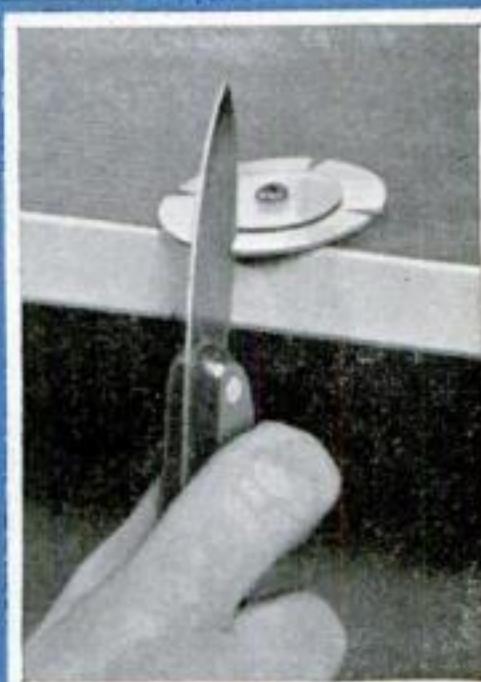
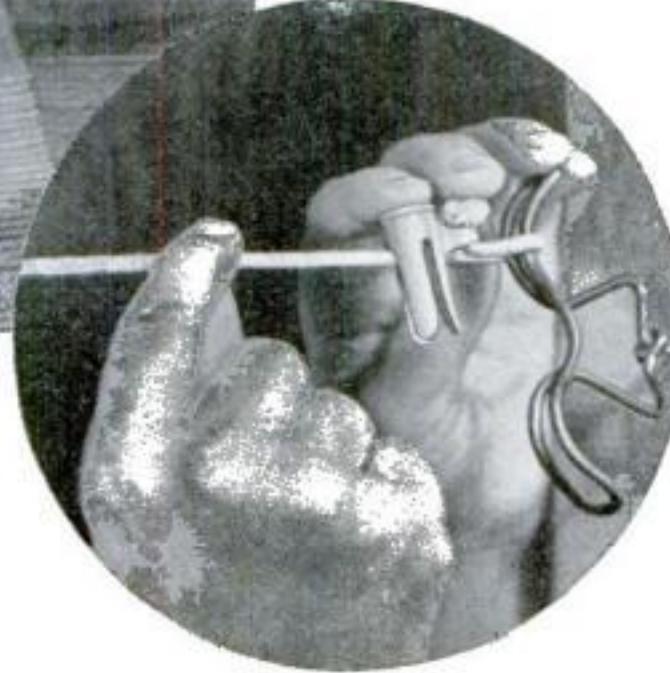
No more pricked fingers putting curtains on stretchers, if you use this handy rubber roller, which presses the curtains smoothly on the stretcher pins



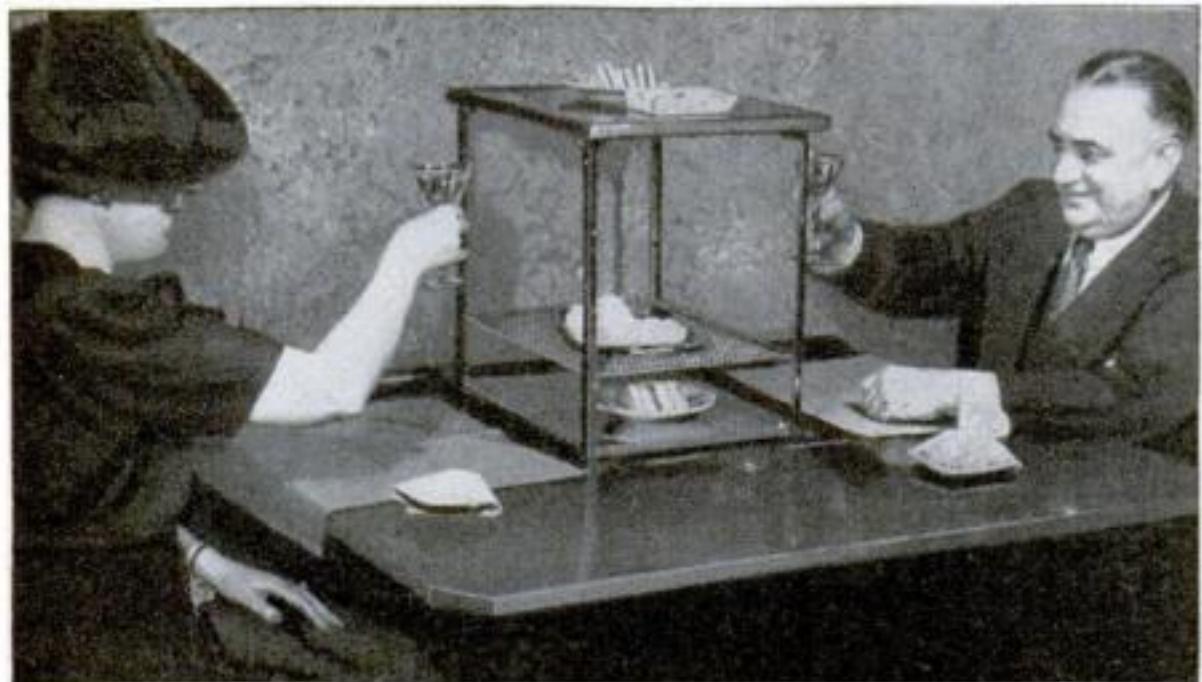
CLOTHESLINE for use indoors has pins at ends for adjusting length, as seen below



SPILLPROOF JIGGER. For measuring ingredients of beverages, the jigger above rests on the edges of the glass. When filled, it is tipped over by turning one of the knobs, and there is no danger of spilling



KNIFE SHARPENER
Screwed to the edge of a shelf or table top, this metal disk has a series of notches in its rim for sharpening knives, as illustrated



A card giving the order is dropped in a handy slot. A minute later a tray with shelves carrying the meal comes up through the table top

Food Pops Out of Table Tops in Cafeteria

FOOD ordered by customers in a novel automatic restaurant recently proposed by a hotel man, pops up out of the center of each table. On entering the restaurant, the diner sits at a table having in its center what appears to be merely a tray. To order his meal, he checks off items of a special card provided for the purpose, which he then drops through a handy slot in the table. Sliding down through a chute to the restaurant kitchen below, the card is picked up, and the order filled. When ready, the meal is placed on shelves of a small elevator, which hauls the food up to the table and deposits it in front of the customer, as shown in the lower photograph at the left.

Rubber Bands Power Model Helicopter

DESIGNED to set a new sustained-flight record, the model helicopter pictured at the right was demonstrated at a recent model-airplane meet. Powered by elastic bands, the model employs two propellers that whirl in opposite directions. An extension at the top of the craft's stick body prevents the propellers from fouling on the ceiling when the model is flown indoors.



Midget Watch Clips to Cuff

A WATCH that can be worn on a shirt cuff, necktie, or vest-pocket rim is a novelty recently marketed. Fitted with a clip that holds it in place securely, the timepiece can also be used by women as an ornament for a hand bag or on a dress.



A wire tip keeps the blades from hitting the ceiling

The Man with the Net

DRONE HONEYBEES have grandfathers but no fathers.

TWELVE STATES have laws against driving an automobile too slowly.

ALCOHOL was once the name of a solid mineral.

WOMEN can bear high tones better than men—and men, as a rule, can bear low tones better than women.



LIVER in the diet aids in preventing hair from turning gray.

"**QUICK AS A WINK**" is eleven one-hundredths of a second.

TERMITE NESTS supply the material for tennis courts in South Africa.

ENGLISH HORNS, employed in symphony orchestras, are not English and they are not horns.

MONEY gets its name from the Roman goddess Juno Moneta.



SLOTHS, traveling at top speed, move at the rate of about one mile an hour.

STRAW, chemically treated, forms a new food for British livestock. Farm animals are said to obtain twice the amount of carbohydrates from the straw after it is treated with a caustic soda solution.

WOLF 457, a recently discovered super-dense star, weighs approximately 18,000,000 pounds a cubic inch.



Handy Nail-Polish Guards

POLISH newly applied to finger nails may be protected from accidental smearing as it dries with novel ventilated finger-nail guards just introduced for beauty-shop and home use. Made of springy metal, the guards are slipped on over the ends of the fingers, as shown in the photograph above, and are held in place by elastic bands.

Three-Hole Paper Punch

THREE correctly spaced holes can be cut at the same time in paper used for loose-leaf folders or notebooks, by means of a compact hand punch now available. Used as shown below, the punch fits easily into a briefcase or desk drawer.



A removable container holds the paper cuttings

HELPS FOR CAMERA

"Wire-Photo" Cameramen Get Portable Darkroom

To SPEED news pictures onto the wires for transmission to cities from remote places, the photographers of one news-picture agency are equipped with the portable developing and enlarging outfit shown in use in the accompanying photograph. Compact-

ly installed in a carrying case, the outfit includes developing tanks, chemicals, and a folding fabric canopy to keep out light, in addition to a plug-in lamp housing, negative carrier, projector, and easel. Finished pictures can be "put on the wire" at the nearest telephone.



How the portable darkroom is set up for field use



Automatic Electric Drier Avoids Brittle Prints

ELECTRICALLY regulated to give a safe amount of heat that its manufacturer claims will prevent paper and emulsion from becoming brittle, the efficient, automatic print drier shown above has a capacity of more than six square feet of drying surface. Designed for either glossy or mat prints, it automatically controls both the temperature of the air from its motor-driven blower and the drying time. Its simplicity of operation makes it adaptable to amateur use.



Twin-Duty Camera Accessory



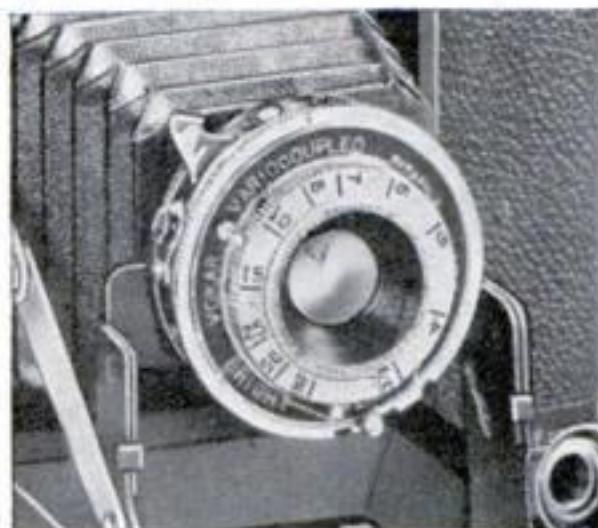
An extinction-type exposure meter and split-image range finder in one unit

A SPLIT-FIELD range finder and an extinction-type exposure meter are now combined in one handy unit that clips on a camera to speed up the making of pictures. Just introduced, the instrument is simple to use. A single knurled wheel is turned to bring the split image together for obtaining the range of the object to be photographed. The exposure meter requires no manipulation whatever, being of the direct-reading type without moving parts. The meter is quickly consulted for exposure factors, since its design makes it unnecessary to consult tables for their interpretation.

AMATEURS

Single Button Adjusts Camera for Making Any Snapshot

AS A convenient time-saver for snapshotters, a new camera is equipped with a lens diaphragm that is coupled to the setting mechanism of the shutter so that only one adjustment is necessary before taking a picture. For example, when taking a picture on a cloudy day, a button on the front of the camera is moved to a point marked "cloudy." The operation determines both the shutter speed and the size of the diaphragm opening so that when the scene is snapped the film will be given just the right amount of light for a good picture.



Thermometer Is Film Agitator

A HANDY new thermometer with a stainless-steel scale and a transparent housing tells the temperature of the interior of a roll-film tank at the same time that it serves as an agitator. A notch in the lower end engages the spiral-type reel of the tank so that it may be revolved by hand in the usual manner. A hole is provided in the top end for hanging it up when it is not in use.

Portrait Makers Get Spotlight

DESIGNED for use with either black-and-white or color film, a new spotlight for amateur portrait makers is available. Because of a special lens, its pre-focused, 200-watt bulb is said to give an output approximating that of many 500-watt spotlights, while the diameter of its light beam is easily altered with different bulbs. A universal mounting permits aiming in any direction.



Photoflash Bulb for Color Film



COATED with a color-corrected blue lacquer, a photoflash lamp made especially for use with color film either indoors or out, day or night, is said to get results as good as those obtainable under daylight. It is designed for either synchronized flash guns or the open-flash method, and matched to outdoor color films.

POPULAR SCIENCE

Question Bee

In each of the paragraphs below, only one statement is correct; see whether you can pick it out. If you don't go haywire on more than four, you'll be doing well. Answers are given on page 239.



1 Indians in the United States (a) have been practically wiped out since the coming of the white man (b) are not nearly half as numerous as in the time of Columbus (c) have recently become the country's fastest-growing population group.

2 That bulging arm muscle some people like to display is the (a) biceps (b) triceps (c) forceps.

3 Purlins are useful because they help support (a) telegraph wires (b) combustion (c) tight-rope walkers (d) roofs (e) impoverished scientists.

4 If you practised legerdemain, you would be able to (a) take notes rapidly in shorthand (b) overpower an adversary of superior strength (c) manipulate the stock market (d) pull rabbits out of a hat.

5 Cordite is (a) a composition for calking the seams of boats (b) a smokeless type of gunpowder (c) the most important ore of chromium.

6 Leaves of a fern are called (a) racemes (b) fronds (c) petioles (d) cilia.

7 From early times, athletes have competed in throwing the (a) stylus (b) discus (c) platypus (d) hibiscus.

8 A print washer is (a) a device for removing printing ink from salvaged paper (b) an aid in finishing photographs (c) an appliance employed in textile dyeing.

9 The opposite of convex is (a) linear (b) acute (c) concave (d) involute.

10 Pythons are (a) marking posts for airplane races (b) newly discovered particles in an atom (c) large snakes (d) vacuum tubes for radio receivers.

11 To check a skid, when you are driving, the thing to do is to (a) slam on the brakes (b) turn the front wheels away from the direction of the skid (c) turn the front wheels in the direction of the skid.

12 All vertebrates have (a) collar bones (b) funny bones (c) wishbones (d) backbones.

13 If a one-inch circle contains 360 degrees, a two-inch circle will contain (a) more degrees (b) less degrees (c) 360 degrees.

14 Naval aircraft carriers employ large numbers of (a) land planes (b) seaplanes (c) amphibian planes (d) aquaplanes.

15 If the coal you burn in your furnace were pure carbon, there would be no appreciable amount of (a) heat (b) ashes (c) draft.

16 A bull moose fights with its (a) tusks (b) claws (c) teeth (d) antlers (e) tail.

17 The outer layer of your skin is called the (a) pericardium (b) epidermis (c) scar tissue (d) retaining wall.

18 You will find about eight teeth to the inch in (a) the gear on your car's flywheel (b) an average cross-cut saw (c) the jaw of a saber-toothed tiger.

19 An exposure meter comes in handy for (a) guarding against sunburn on the beach (b) setting the shutter speed of a camera correctly (c) determining which way a new house should face.

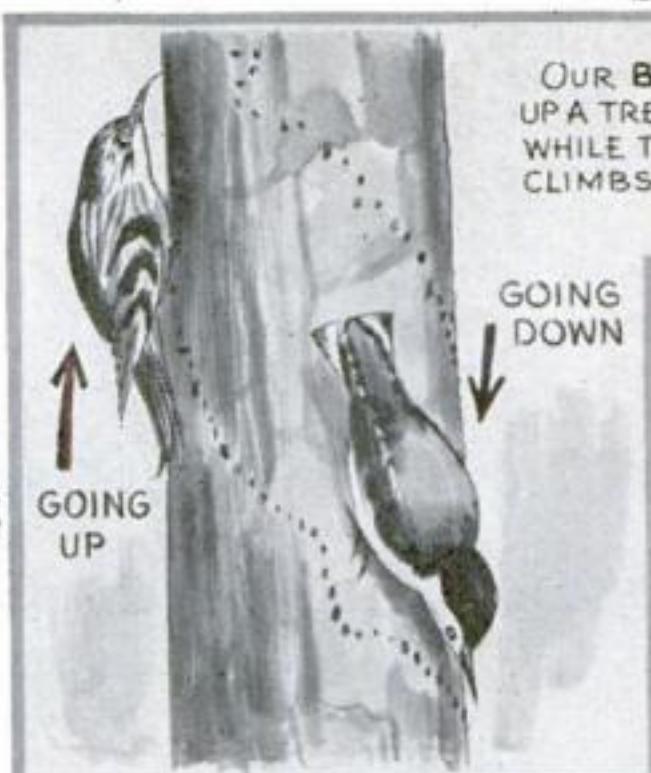
20 A bit brace of the ratchet type has the advantage that it (a) folds into small space for storage (b) takes the most varied assortment of bits (c) can be used in a tight corner (d) will bore holes in ratchets.

Un-Natural History

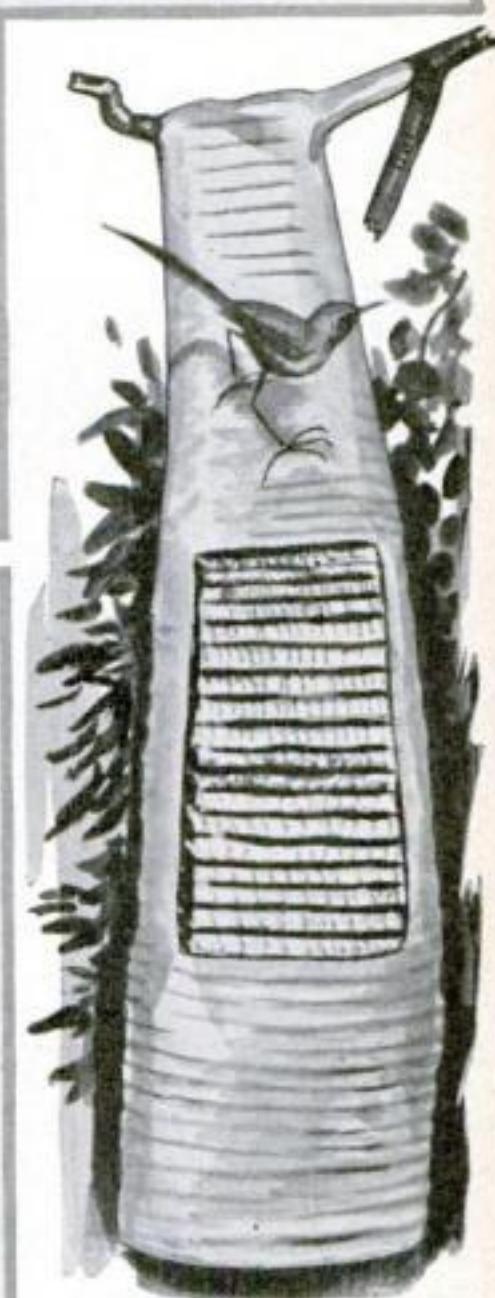
By
Gus Mager



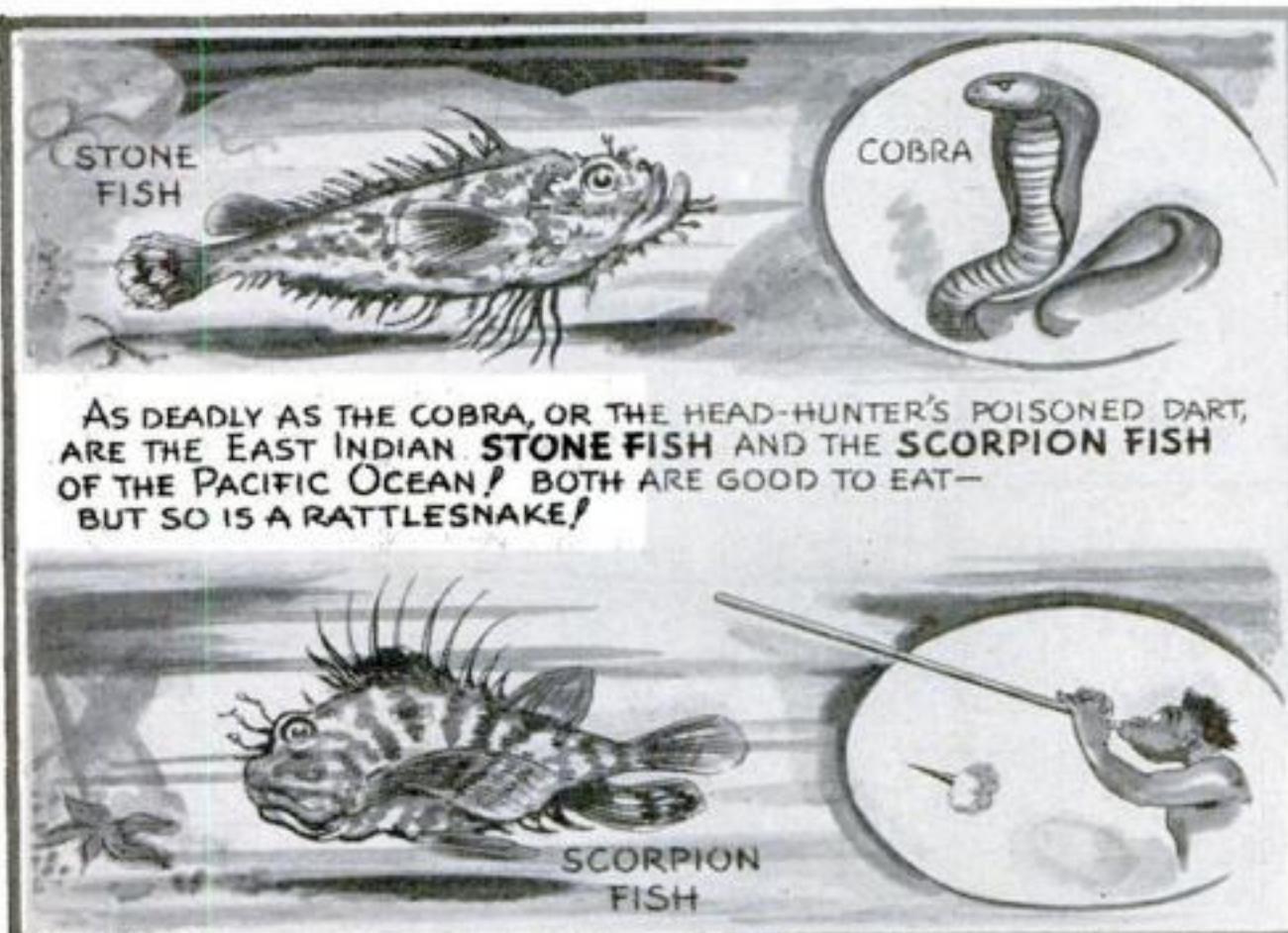
PENGUINS ARE FOUND ONLY IN THE ANTARCTIC, WITH THE EXCEPTION OF ONE VARIETY ON THE COAST OF PERU AND NEAR-BY ISLANDS!



OUR BROWN CREEPER CLIMBS UP A TREE TRUNK AS IT EATS, WHILE THE NUTHATCH CLIMBS DOWN!

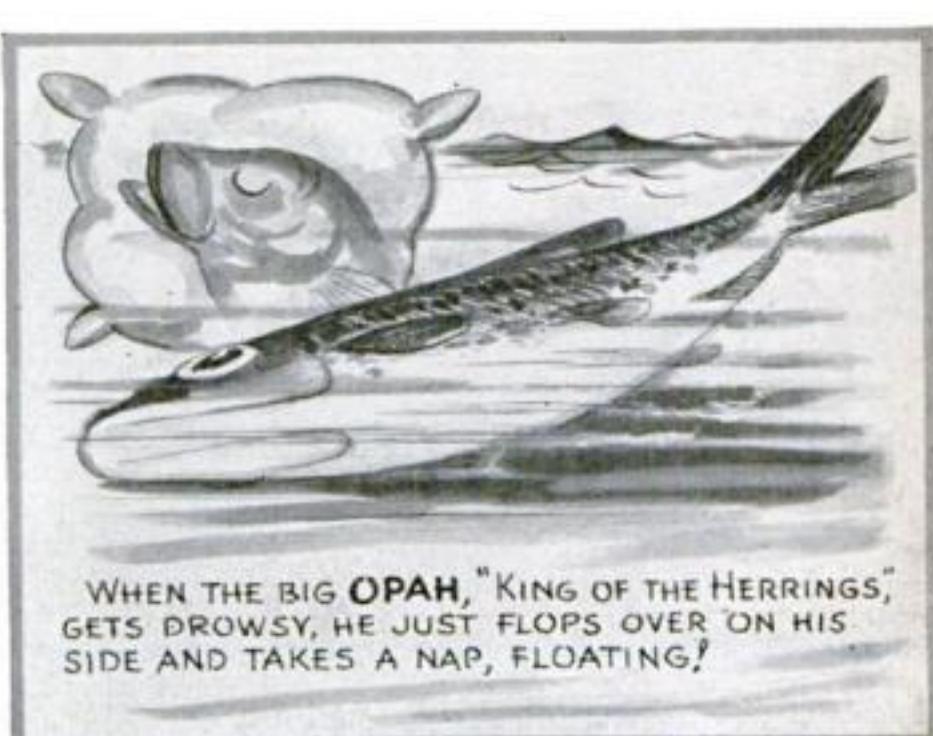
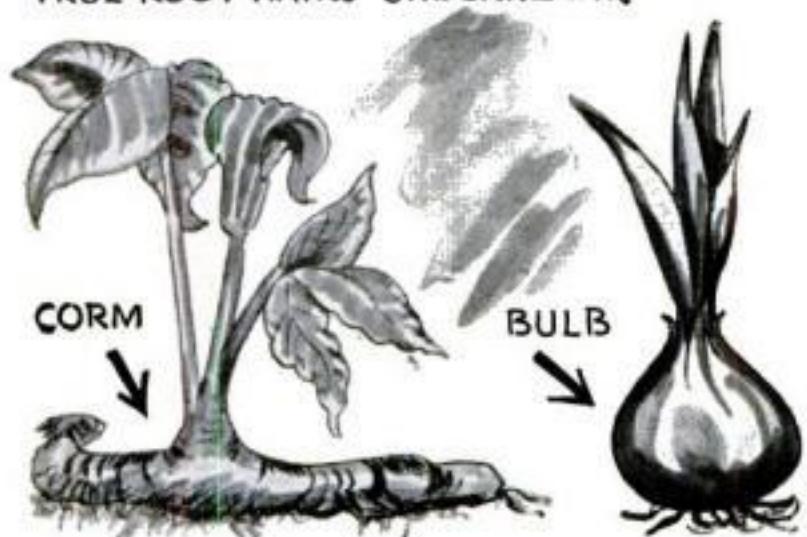


FORTY-STORY APARTMENT HOUSES WITH WALK-UP PASSAGeways (NO ELEVATORS) ARE BUILT BY CERTAIN BRAZILIAN WASPS!



AS DEADLY AS THE COBRA, OR THE HEAD-HUNTER'S POISONED DART, ARE THE EAST INDIAN STONE FISH AND THE SCORPION FISH OF THE PACIFIC OCEAN! BOTH ARE GOOD TO EAT—BUT SO IS A RATTLESNAKE!

LEAVES NEVER GROW DIRECTLY FROM TRUE ROOTS! THE JACK-IN-THE-PULPIT, FOR EXAMPLE, SPRINGS FROM A CORM AND THE ONION FROM A BULB, BOTH OF WHICH ARE FALSE ROOTS WITH THE TRUE ROOT HAIRS UNDERNEATH!



WHEN THE BIG OPAH, "KING OF THE HERRINGS," GETS DROWSY, HE JUST FLOPS OVER ON HIS SIDE AND TAKES A NAP, FLOATING!

"Watch that spark, Doc," instructed Gus Wilson, indicating the gap. "It will tell us the whole story."



"STARTS hard, and stalls in traffic once in a while, hey?" Gus Wilson said: "I guess you know the answer as well as I do, Doc. A hundred to one something has gone wrong in your ignition system."

Dr. Marvin, who in addition to being the town's top children's physician is an enthusiastic amateur automobile mechanic, nodded agreement. "That's what I figured," he said. "But I haven't had a chance to locate the trouble. It might be in the distributor, it might be in the coil, and it might be in the condenser."

"Yep," Gus agreed as he fired up his pipe. "And then again, it might be in the wiring. Wiring can play you some funny tricks. Just this morning a young fellow drove a '31 sedan in here to have a new battery cable put in. He said he'd bought the job dirt cheap a couple of weeks ago, but at that he'd got stung, because it had a grabbing clutch that made the car jerk whenever he started out. He said that he'd had the bus in a half dozen shops, and that after testing it, each said that the clutch was bad.

"Well, I put in a new battery ground cable, and then I thought I'd better take a quick look at the rest of the wiring. As soon as I'd taken up the floor boards I noticed that the insulation of the other battery cable,

Gus BUILDS AN **IGNITION TESTER**

the one which runs from the battery to the starting-motor switch, had been chewed off right down to the bare wire. The cable ran under the floor boards close to the clutch pedal, and the cotter pin in the pedal joint had worked part way out and cut into the insulation every time the pedal was moved. Of course, whenever the pin came in contact with the bare wire the result was a short which made the engine skip and the car jerk. That was the 'bad clutch' which made the young fellow so sure that he had been gypped. I fixed it by taping the bad spot and putting in a new cotter pin—and saved him somewhere between ten and twenty bucks."

"That was a queer one," Dr. Marvin said interestedly. "I remember one something

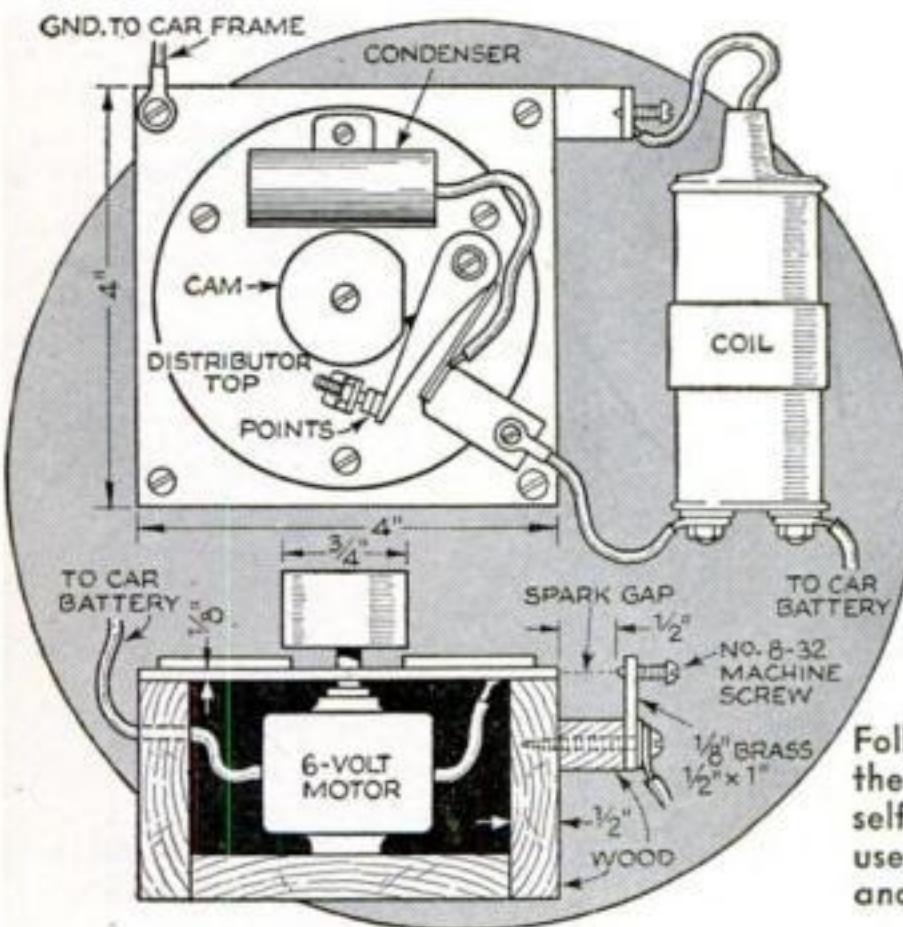
like it. Once I was having trouble with—" He broke off and looked at his watch. "Darn you, Gus Wilson!" he growled. "Every time I come into this shop I get listening to you and fall away behind on my schedule! I've got a lot of calls to make this afternoon, but I'd like to get you to check my ignition and fix up whatever is wrong with it. Suppose I send the car over about four o'clock—could you get it ready so that I could use it tomorrow morning? I don't think I'll have to make any calls this evening. If I do, I'll get a taxi. I hate to ask you to work overtime, but—"

"That's all right," Gus assured him. "You do a lot of overtime work, Doc; why shouldn't I? But if you're not doing anything special this evening, why not bring the car over yourself about half past seven? If you do, I'll show you how to make a simple little gadget which makes locating ignition trouble a cinch. I used to have one and for a long time I've been intending to make another. How about it?"

"Maybe I'll have as much fun with it as I've had with that vacuum tester you made me," the doctor said. "All right, Gus—I'll be here!"

When Dr. Marvin arrived he found Gus Wilson's workbench already covered with shavings, and Gus plastering a bandage around a cut thumb. "Darn it all," he said disgustedly, "I can work on engines all the time and not hurt my hands twice in a year, but every time I start fooling with a wood saw or a chisel I cut myself. I guess I'll have to admit that I'm no carpenter."

"Let's see that cut," the doctor said. "Put some iodine on it? All right—I guess you'll get over it. What do you call this gadget of yours? And what are you doing, and what do you want me to do?"



Follow this sketch to make the ignition tester yourself. Gus tells you how to use it in the story as he and Doc Marvin build one

He's No Carpenter, but the Model Garage Boss Turns Out a Slick Job, Anyhow, Along with Good Ignition Advice

By MARTIN BUNN

"I call it an ignition analyzer," Gus said. "I'm making a wooden box, 4" square and 2½" deep, out of ½" stuff. Here's a job for you." He handed Dr. Marvin a 1"-long piece of ¾" brass rod, and a large file. "Just file one side of that until you have a ½" flat surface on it, will you?"

They worked for a while in a companionable silence and an ever-thickening cloud of pipe smoke. Gus finished his box, and to one side of it screwed a 5/8"-square block of wood. To this block he screwed a 1" by 5/8" strip of ½" metal, threaded near its upper end to take an 8-32 machine screw. Then he went over to the other side of the shop and began to rummage through a big box in which he keeps a collection of old car parts. Finding what he was looking for, he came back to his workbench just as Dr. Marvin finished his filing job.

He held up the object that he had salvaged from what his partner, Joe Clark, contemptuously calls the junk box. "This is an old windshield-fan motor," he said, "but it works all right. You can buy a new one in any accessory store. The motor from one of those old motor-driven horns will do just as well, if you happen to have one around your garage. Now I'll drill a hole through that piece of brass rod you've been filing so industriously . . . so. And now I'll fasten it with a machine screw to the threaded hole I put in the end of the motor shaft . . . so. Now that will be all right."

"I wish," Dr. Marvin said, "you'd tell me what the devil you're driving at!"

Gus grinned widely. "Patience is a virtue—I'll bet you've pulled that line many a time, Doc. Just wait until I've finished up a couple of other little jobs, and I'll tell you all about it." He screwed the fan motor securely to the bottom of the box, with its shaft pointing upward. Then he attached a metal top to the box, through which the piece of flattened brass rod fastened to the

end of the shaft protruded, its lower edge a scant ¼" above it. Then he took an 8-32 machine screw, filed its end to a point, and screwed it through the

strip of metal he had fastened to the wooden block he had screwed to the outside of the box. "There you are!" he said. "The Gus Wilson Ignition Analyzer—all ready to analyze!"

Dr. Marvin examined the gadget carefully, and then shook his head. "It just doesn't make sense to me," he admitted.

Gus laughed. "It will," he said. "If you'll drive your car in, Doc, and park it as close to the bench as you can, this little instrument will tell you exactly what has gone wrong with your ignition system, without you having to move away from this bench."

Dr. Marvin drove his car in and stopped it close to the bench. Gus raised the hood, took off the distributor cap, unscrewed the head plate which carried the points and condenser, removed it, and then mounted it on the metal top of the analyzer box, as shown in the drawing. "You'll notice," he said, "that the flattened brass rod takes the place of the cam used in the car to open the points. When the motor of the analyzer is rotating, the points will be opened once with every revolution of the motor's shaft."

He took the ignition coil out of the car, placed it on the bench, and connected it to the analyzer, the wire from the coil's high-tension terminal running to the head of the pointed machine screw. "This is important," he said as he adjusted the screw carefully. "There must be a gap of exactly $\frac{1}{2}$ " between the point of the screw and the metal plate on the top of the box." Then he connected the analyzer to the car's frame for a ground.

"WHEN I start the motor," he explained, "we should get a spark across that gap between the point of the screw and the metal top of the box. Watch that spark, Doc. It will tell us the whole story. If it jumps right across the gap, and is fat and blue-white, there's nothing wrong with your ignition system. If the spark doesn't jump the gap, or isn't fat and blue-white, then there's something wrong—and the spark will tell us what it is. Let's go!"

He switched on the tiny electric motor. The spark jumped the gap, all right, but it wasn't fat and blue-white. It was stringy, and reddish in color. Gus watched it for a few seconds, and then switched off the motor. "Thought so," he said. "The trouble is

an open circuit in the coil's secondary winding. That's what's been causing those hard starts and the stalling in traffic that you told me about. There's only one sensible remedy, Doc—a new coil. No sense fooling with this one. Sooner or later the 'open' will become longer, and then your engine won't start at all."

"All right," Dr. Marvin said. "Put in a new coil. Have you got one on hand?"

Gus nodded. "Before I put it in your car," he said, "we'll test it out on the analyzer."

Gus soon came back from the stock room with the new coil, and connected it to the analyzer in place of the old one. Then he switched on the electric motor again. The spark began to jump the gap with a peppery crack-crack-crack—a spark that was fat and hot and

blue-white. They watched it for a half minute, and then Gus switched off the analyzer motor.

"Well," Dr. Marvin said, "your ignition analyzer has proved to my satisfaction that I needed a new coil, and I haven't the slightest doubt that the new coil will do away with the trouble I've been having. That's all to the good. But suppose the trouble had been caused by something else. How would your analyzer have shown it up then?"

Gus perched his large frame on his work-bench. "To tell you what you want to know, I'll have to sound off for a few minutes." He grinned cheerfully. "Well, now, the main thing to keep in mind is that when the analyzer produces a fat, blue-white spark which jumps the full half-inch gap, there's not a thing wrong with your ignition system, but when the analyzer doesn't produce that kind of spark, there is something wrong with your ignition system.

"Suppose you start the analyzer motor, and the resulting spark is fat and blue-white, but doesn't jump more than $\frac{1}{8}$ ". That shows that your coil has shorted turns in its secondary. The sensible remedy is the same as for a coil with an open circuit in its secondary—a new coil.

"Sometimes you get a fat, blue-white spark which is a full $\frac{1}{2}$ " long, but which misses now and then. That sort of spark makes an engine stall while it's idling, and is the cause of poor acceleration and of bucking. The trouble is a coil which 'opens' intermittently. (Continued on page 236)

GUS SAYS:

A lot of drivers wouldn't have worn-out starters and batteries now if they'd bought new plugs last fall. And a lot more will pay more than they need to this summer for gasoline because they didn't get new plugs in the spring. Why? It's too much for me!

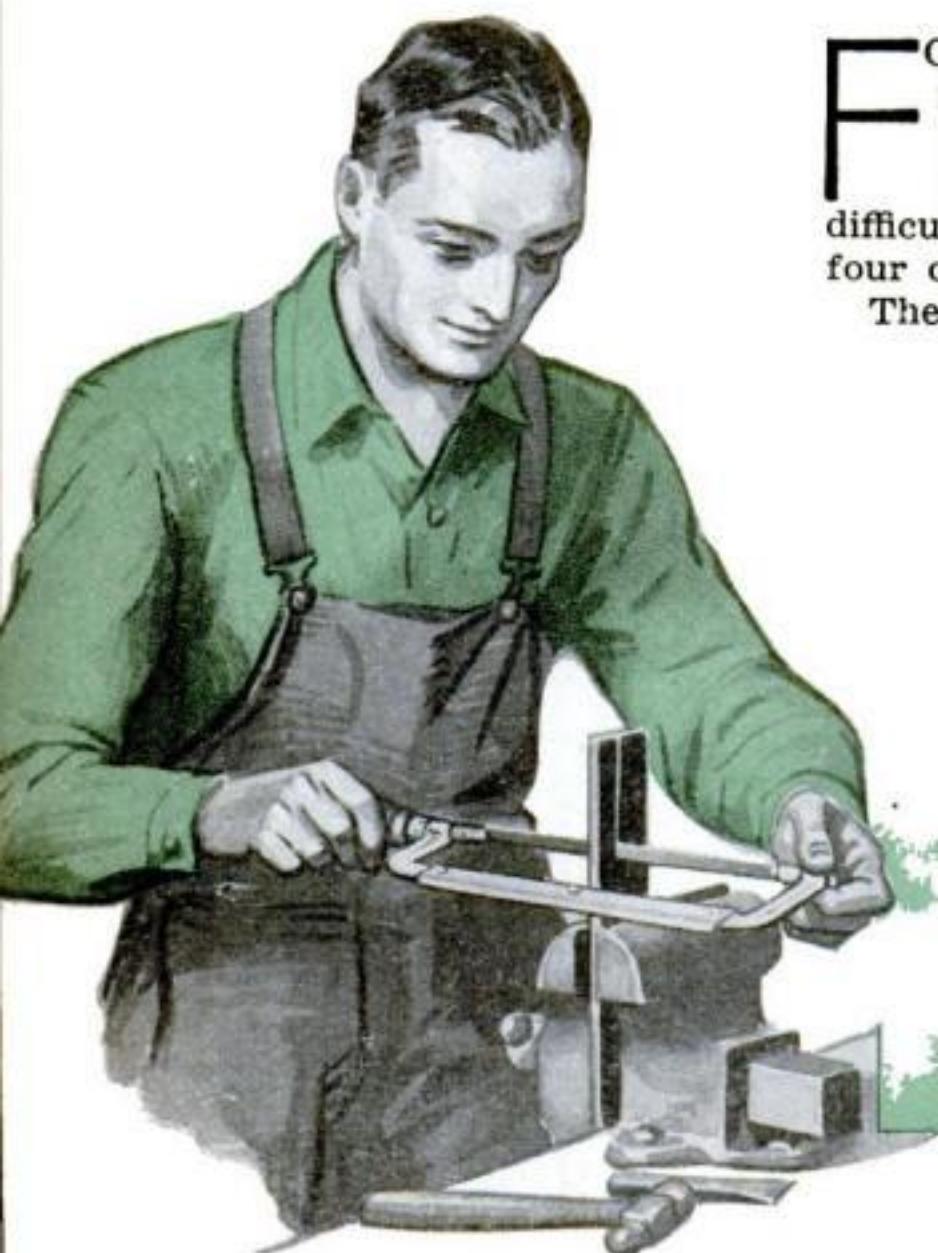
THE HOME WORKSHOP



In This Issue..

- Modern Crossbow
- City-Lot Gardens
- 18th-Century Secretary
- Simply Made Enlarger
- Fireplace Screen

"Ye Atom Smasher" . . .

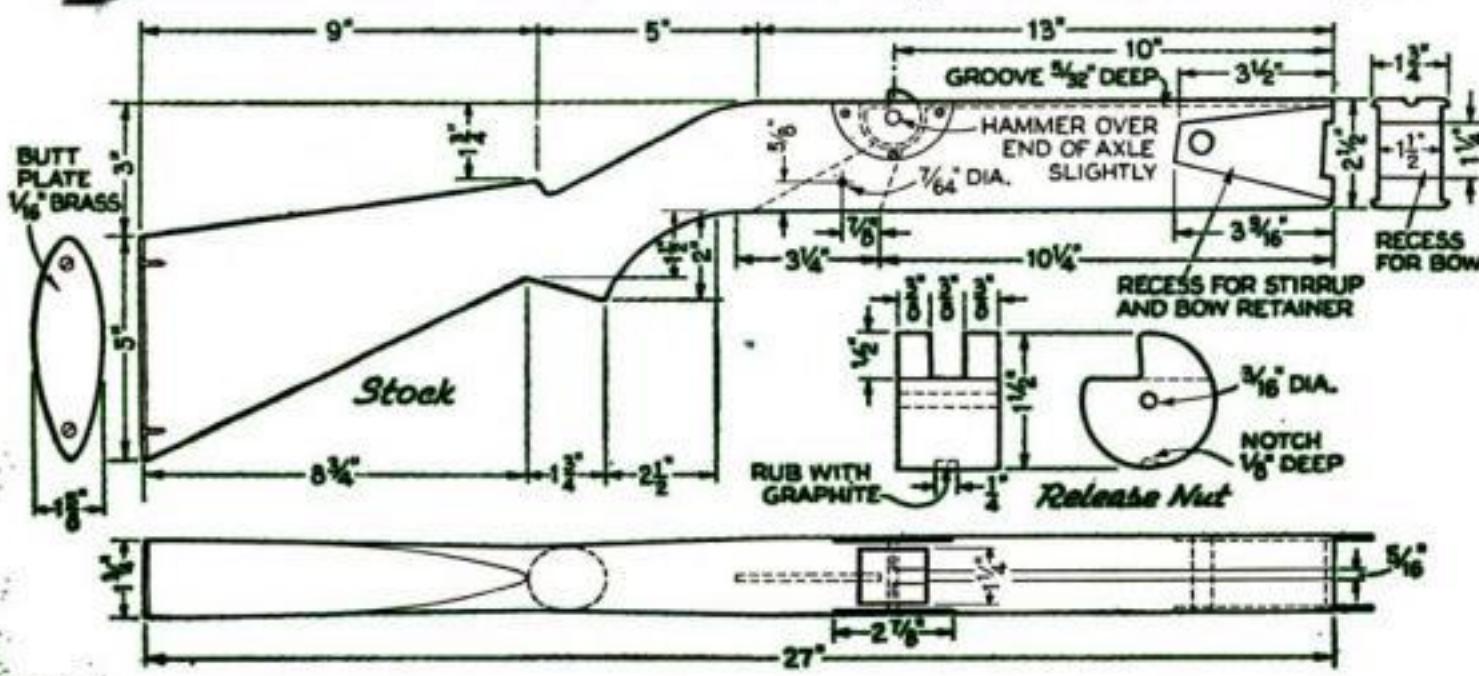
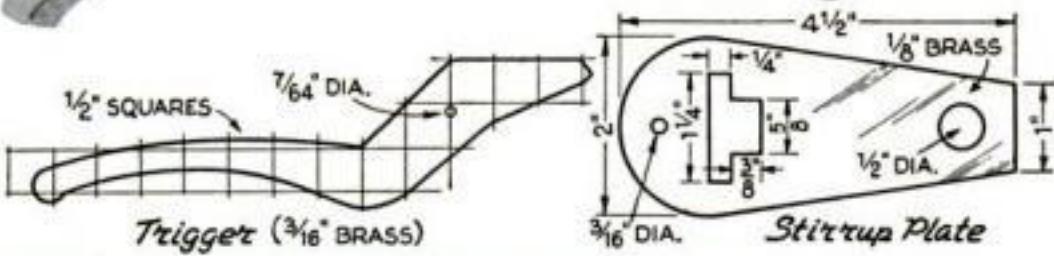
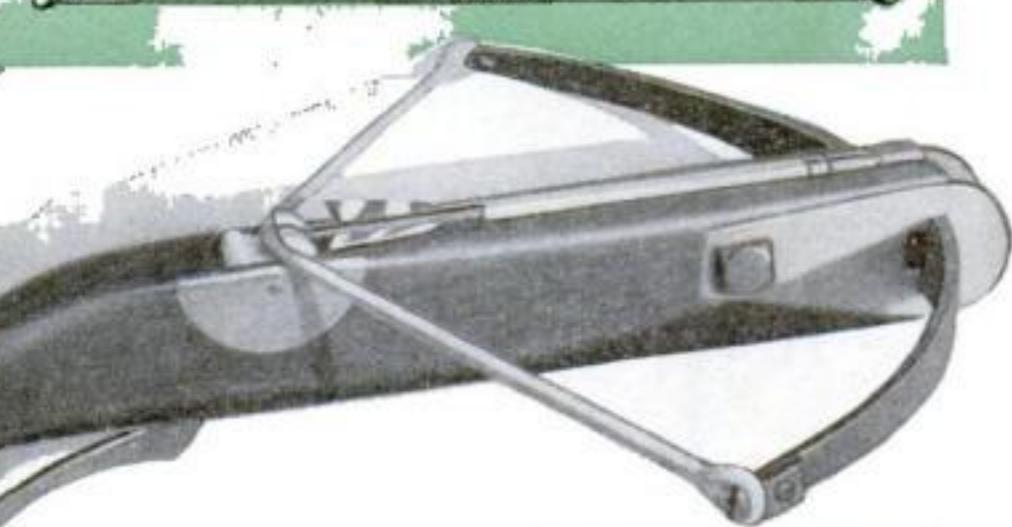
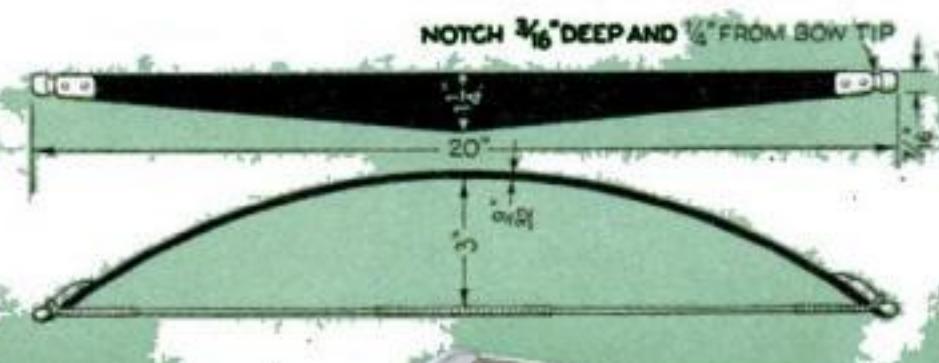


The bow is a leaf from a light auto spring, hack-sawed to shape

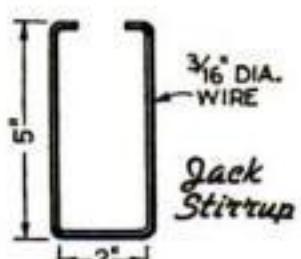
FOR the dub archer, hopelessly infected with the romance of medieval weapons, a crossbow should be the answer. A sporting crossbow is easier to make than a really good long bow and is much less difficult to shoot accurately. The cost should not exceed four or five dollars.

The power of a crossbow like the one illustrated is invariably a surprise to those not familiar with archery. In one test it shot a bolt (arrow) not only through a thick telephone directory, but also through a $3/32$ " piece of sheet steel used to back it up! Such a powerful weapon must always be used with the utmost caution.

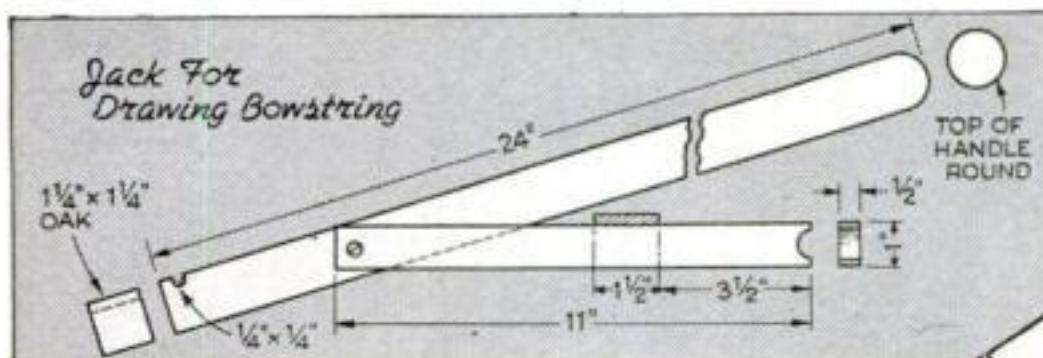
The Bow. A junkyard will supply a light auto spring for the bow (an Austin spring was used in the original model). Trim it with a



The hardwood stock is sawed as at the left. Other important details are the release nut and trigger, the bow stirrups, and the jack stirrup



A Modern Crossbow



Leverage for drawing the bowstring is gained by means of a jack made as above and used as at right

By GEORGE F. SNELL, JR.

hack saw to the shape shown. By this method the taper is all on the bottom edge of the bow, an advantage in crossbow construction. For nocks to attach the bowstring, use blanks of horn or hardwood, $1\frac{3}{8}$ " by $\frac{5}{8}$ " by $\frac{3}{8}$ ", drilled, countersunk, and riveted to the bow with $3/16$ " flathead brass stove bolts. Rough them into shape with rasp or sanding wheel. Cut the string grooves with a $7/32$ " rat-tail file.

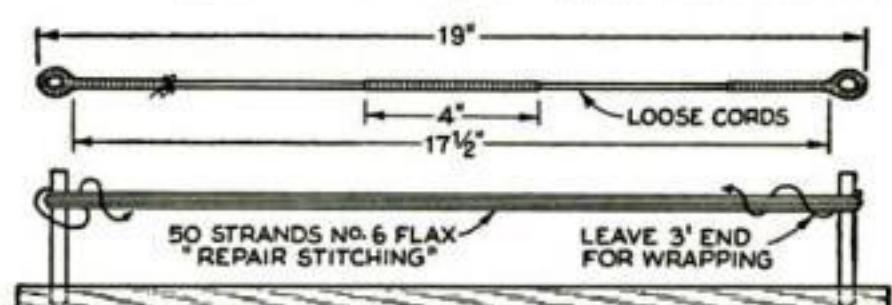
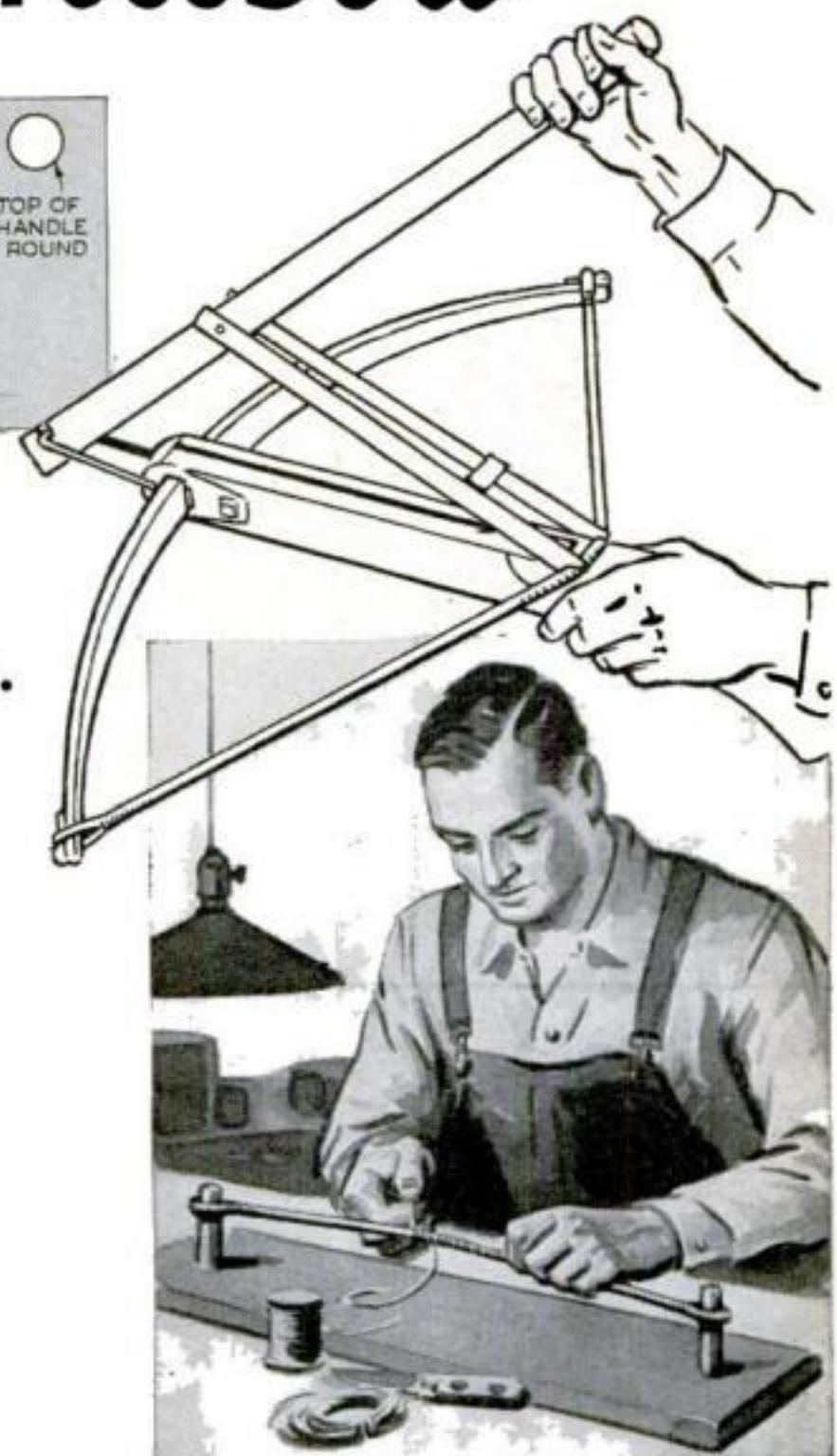
Release Nut and Trigger. Ivory makes the best release nut. Substitutes are aluminum, brass, Babbitt, or phenol-formaldehyde composition. If an old billiard ball is available, it can be turned down at low speed between live and dead centers with a file ground like a parting tool. Make the string and trigger notches as shown.

Cut the trigger with a hack saw and finish with a file. A long trigger is necessary because of pressure on the nut. This pressure also requires the use of plate-brass bearings, as diagrammed, for the release-nut axle.

The Stock. The stock is cut from 2" by 8" by 27" walnut. Hardwood is preferable because it is easier to groove accurately. Rough out the blank according to the drawings, marking holes for the axles of trigger and release nut. Cut the bolt groove with router or saw. Make the initial cut a shallow one, then enlarge it with a $5/16$ " rat-tail file. Chisel out trigger and release-nut recesses.

Cut bow stirrup plates from $1/8$ " brass as shown and file the slots, enlarging them as necessary to fit the bow; then fit them to the stock. When they fit snugly into their recesses in the stock, bore for the $1/2$ " bolt that fastens stirrups and bow securely in place. Bend the stirrup to hold the loading jack from $3/16$ " wire, and fit in the bow stirrups.

Shape the stock with a drawknife and



How to Make the Bowstring

A simple wooden jig is used for laying up the bowstring, which is formed of high-grade linen thread

rasp. Round the barrel on either side of the groove to reduce friction on the string. Fit the butt plate before finishing the stock with varnish or oil.

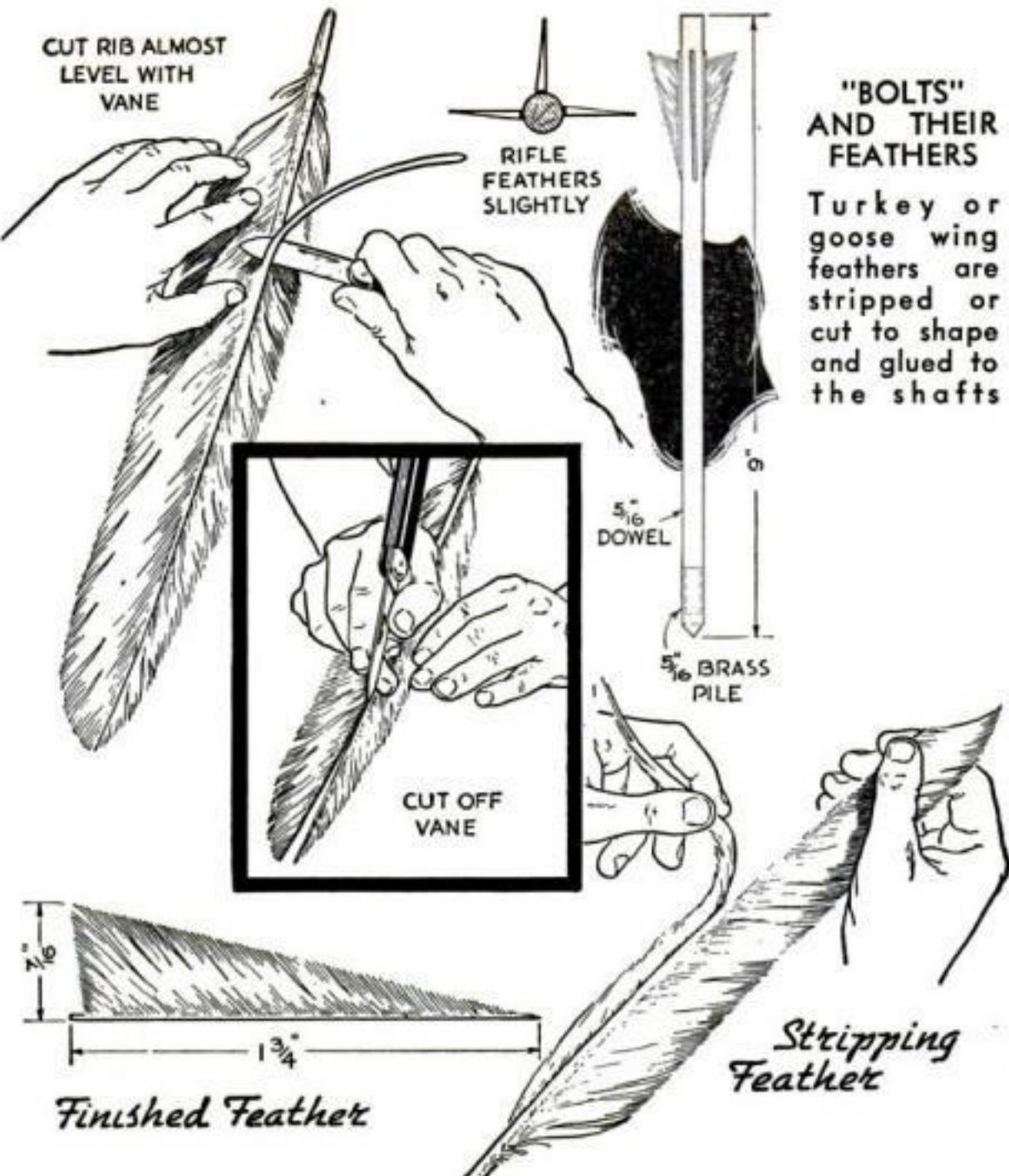
Jack for Drawing Bowstring. Because of the strength of the steel spring, it is necessary to have some mechanical aid in drawing back the bowstring so as to catch it over the nut. A hinged wooden jack is used for this purpose. It is made as shown in the drawings and used as illustrated.

The Bolts. Bolts can be made of $5/16$ " commercial doweling or by planing the

corners from $11/32$ " squares of wood and sanding to size in a chuck. Birch or fir dowels are best. Turn or whittle shoulders for the target points or piles. These can be purchased at sporting goods stores or from dealers in archery supplies. Clinch in place with a center punch and cut off the dowels to a length of 9" from tip to butt. Sand the butt diameter to $1/4$ ". A nock is not required for the bowstring.

Turkey or goose feathers are best. Use the stiffest "flight feathers" of the wing. Select three feathers from the same wing of the bird, that is, all right or all left. Lay the feathers on a board, held flat under outstretched finger and thumb, and cut off the rib almost level with the vane, using a sharp knife. Next hold the blade like a pen, guide it by running the second finger along the flattened rib, and cut off the vane and a $1/32$ " strip of rib with it.

Another simple method is to strip off the wide part of the feather by pulling its papery root tegument from the rib. This is done by a steady pull, the rib being held in one hand and the vane in the



other. Three finished feathers usually can be cut from the widest part of one vane.

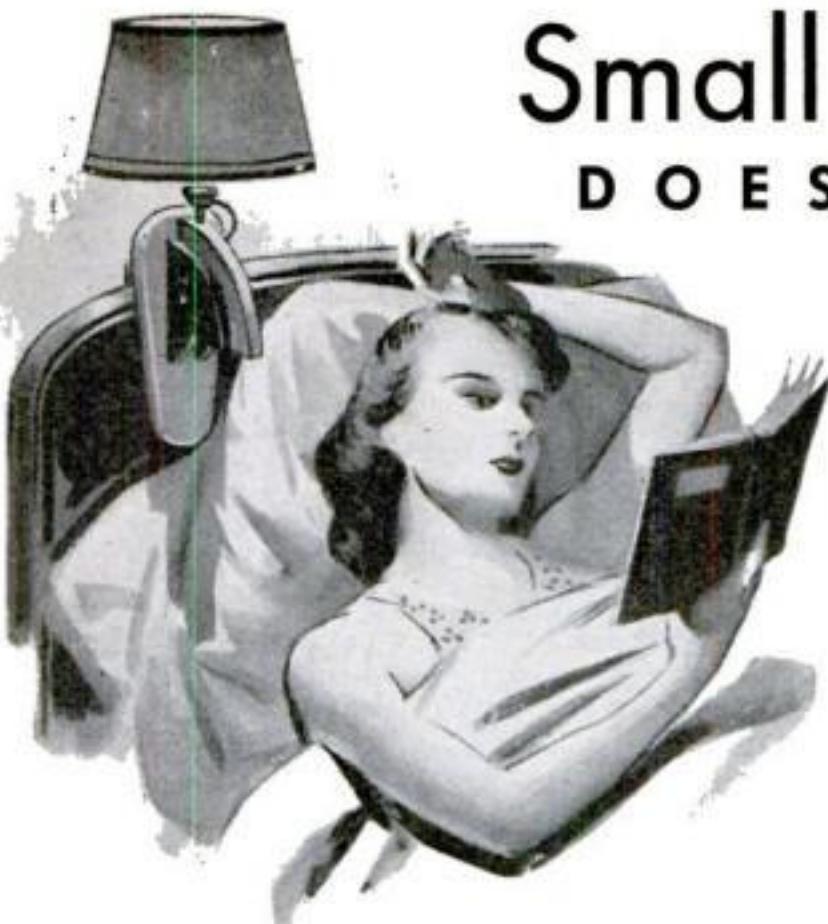
Trim the feathers to shape and moisten between layers of damp newspaper. Apply hot glue thinly to the base of a feather, lay it on the shaft, and hold in place for a moment. When the glue has set, sand the bolt again lightly, and paint to suit your fancy. Finish with varnish.

The Bowstring. This is made of high-grade linen thread usually specified as "No. 6 flax repair stitching." Get about 60 yd. from your shoemaker. Other very strong flax threads can be used. Make the string according to the diagram, and rub the center wrapping with paraffin to reduce friction on the barrel.

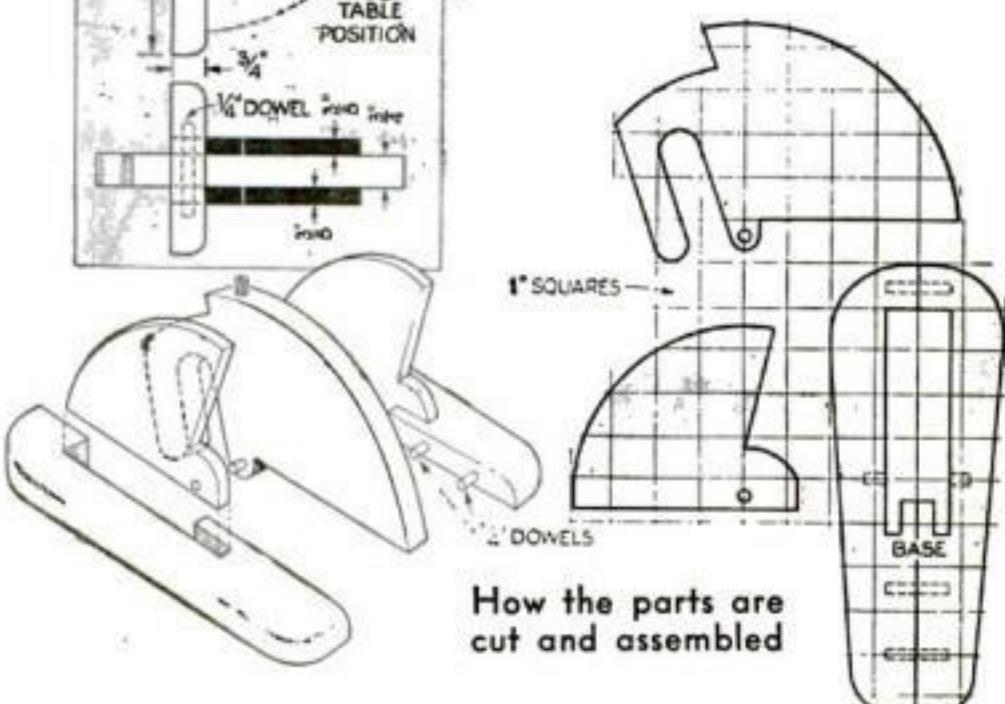
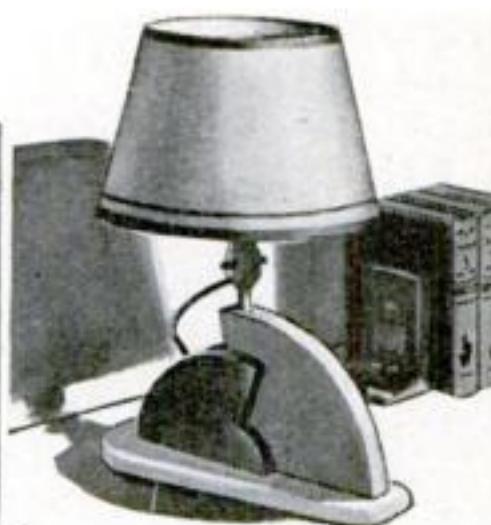
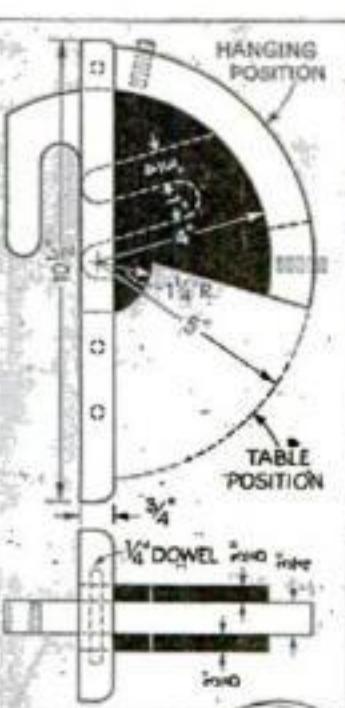
String the bow by making a lighter false or temporary string long enough to be slipped over the nocks without bending the bow. Put the true string on the bow, one loop in a nock, the other sliding on a limb. Place the false string over the true and bend bow with the jack until the true string can be set in place. Now jerk out the false string. The crossbow can be left strung all the time.

In ancient times, the sporting crossbow was used for hunting or for competitive shooting at the butts.

Small Modern Lamp DOES DOUBLE DUTY



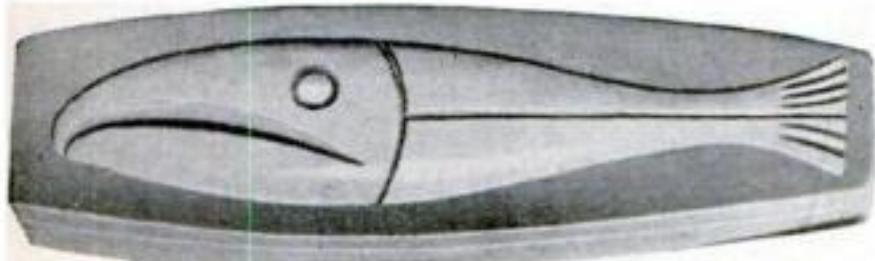
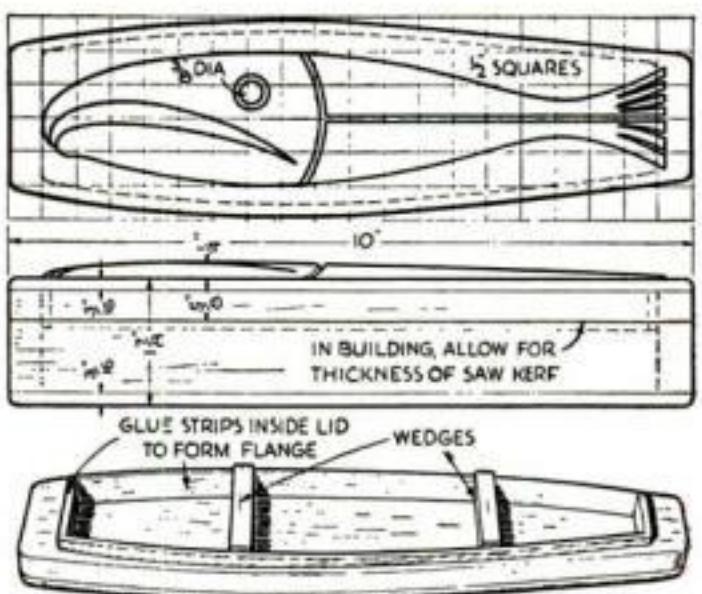
CONSTRUCTED of contrasting woods such as maple and walnut or finished in colored enamels, this modern lamp can be used on a table or desk and also hung up as a bed lamp. The base is made in two halves and the center wing swivels on a $\frac{1}{4}$ " dowel. The outside wings are glued in the two halves of the base; then, when the center section is in place, the base is glued together with dowel pins. A socket nipple is threaded tightly into a hole drilled slightly small and about 2" deep. Obtain a socket cap or bushing that has a side opening for the wire to run through. Finish with



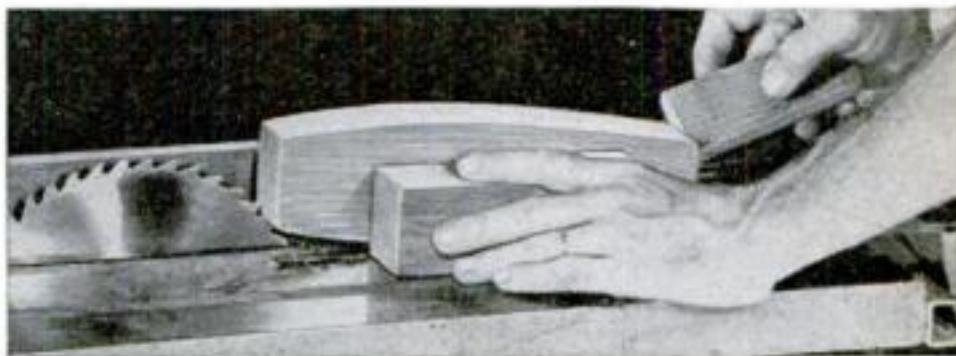
How the parts are cut and assembled

shellac or varnish, or with enamels, and glue a felt pad to the bottom and a strip of felt inside the hook.—J. BRUMFIELD.

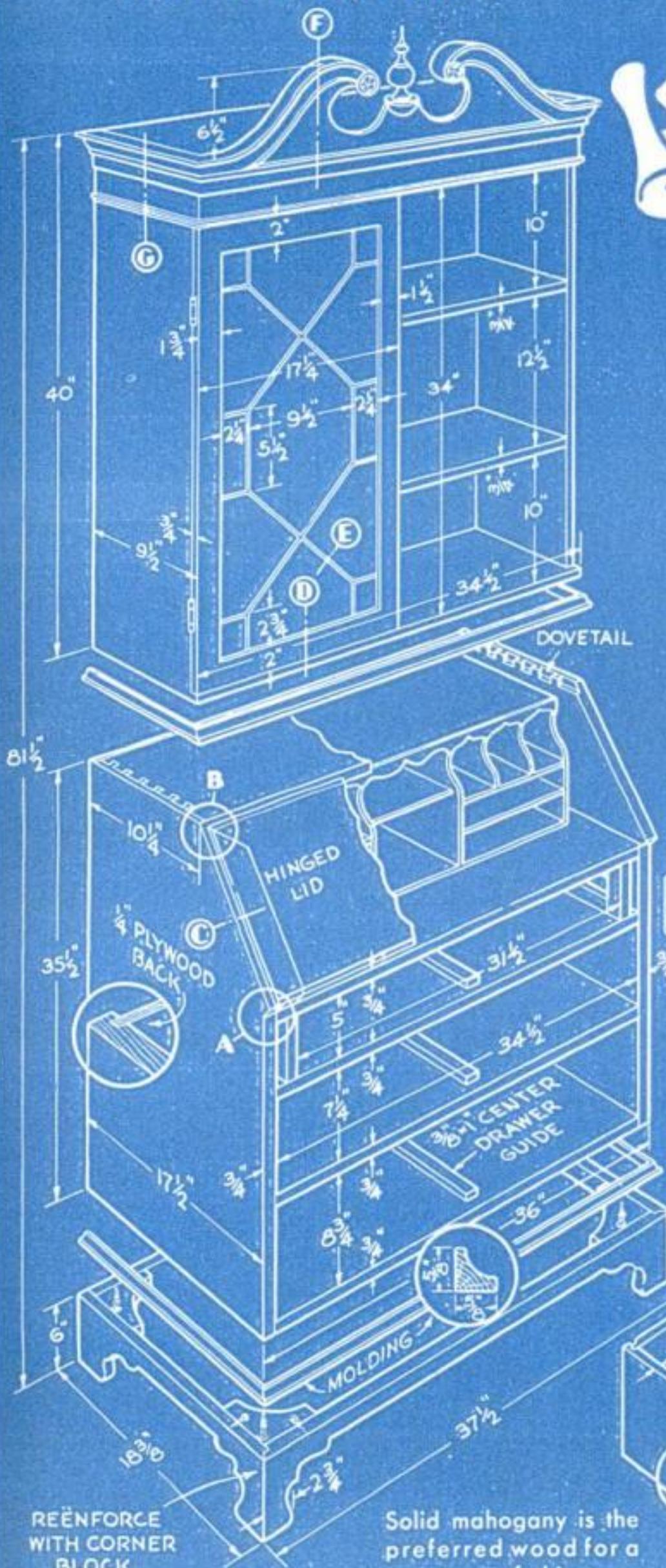
Unique Jewel Box Copied from Old Eskimo Design



ALTHOUGH it bears a remarkably modernistic design of a salmon, this jewel case is a copy of an old Eskimo trinket box. After the outside has been shaped, the inside of the box can be band-sawed, the entrance kerf through one end being puttied later on. Glue on the top and bottom, sand to shape, and saw off the lid on the circular saw. Glue strips inside the lid to form a flange. The carving is an overlay roughed from $\frac{1}{4}$ " stock and glued to the top. A good color scheme is white or ivory, with lines, mouth, and background of the fish in dull yellow. Line the inside with leather.—E. L.

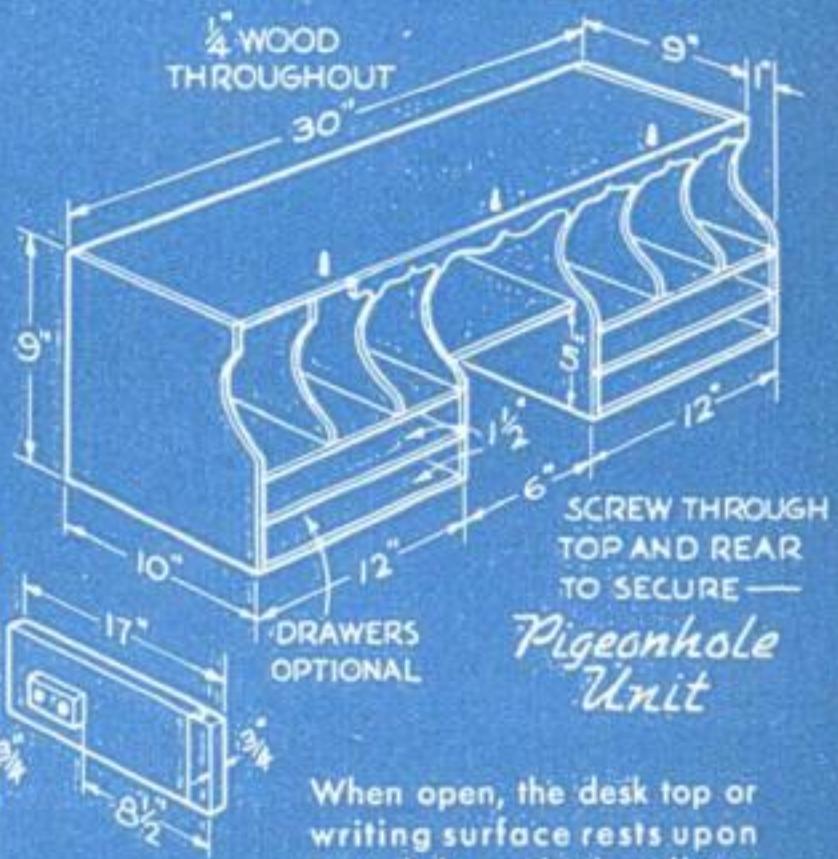


Designed by
DONALD A. PRICE



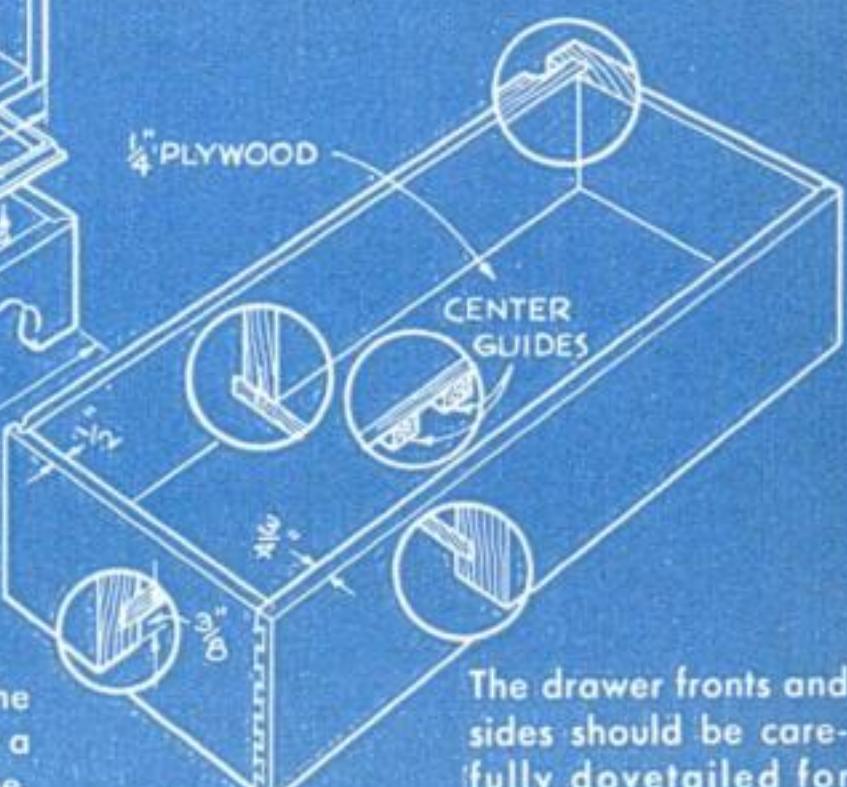
Solid mahogany is the preferred wood for a secretary of this type, but walnut may be used

18th Century Secretary



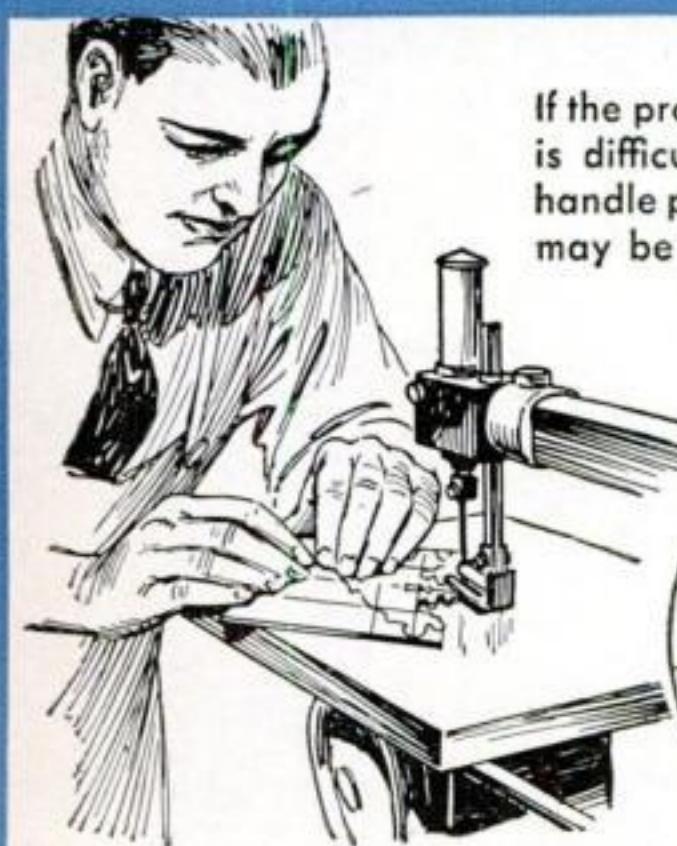
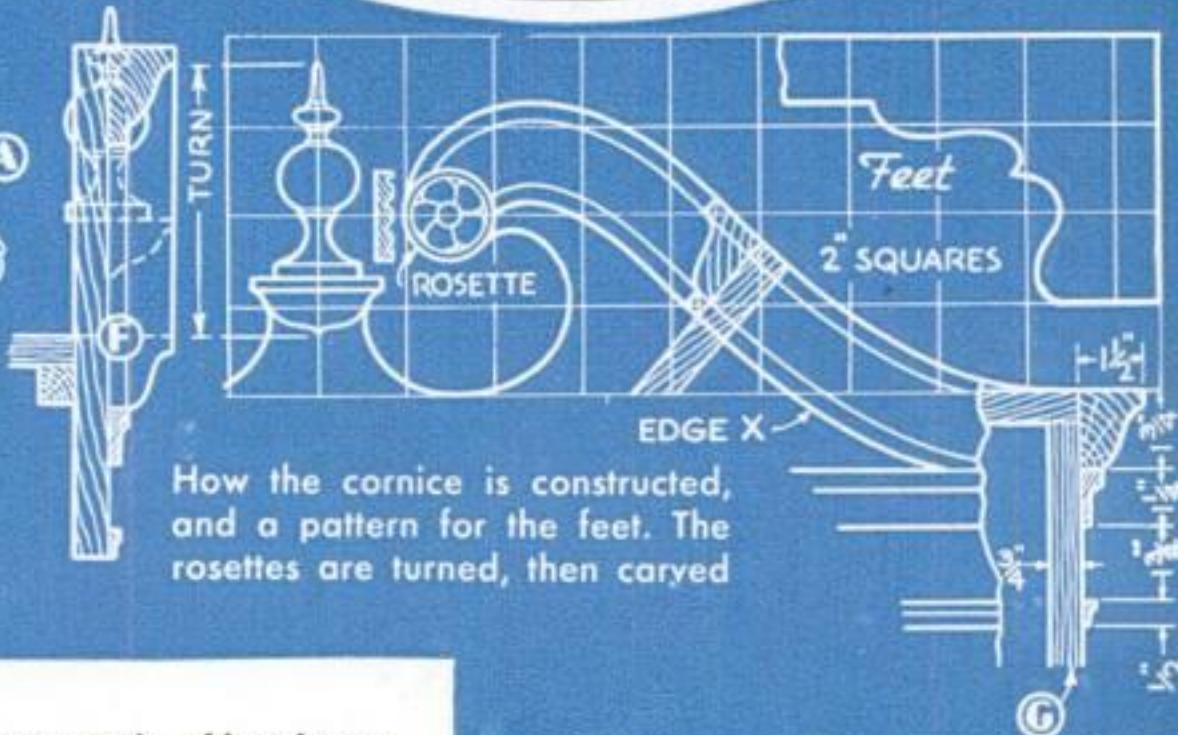
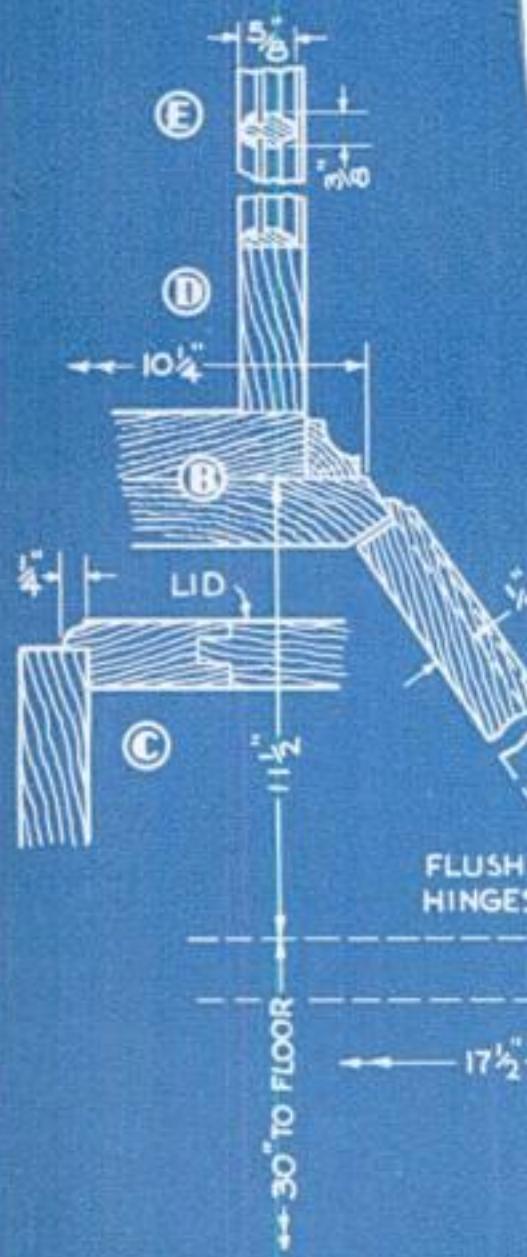
SCREW THROUGH
TOP AND REAR
TO SECURE—
*Pigeonhole
Unit*

When open, the desk top or writing surface rests upon two slides, which pull out

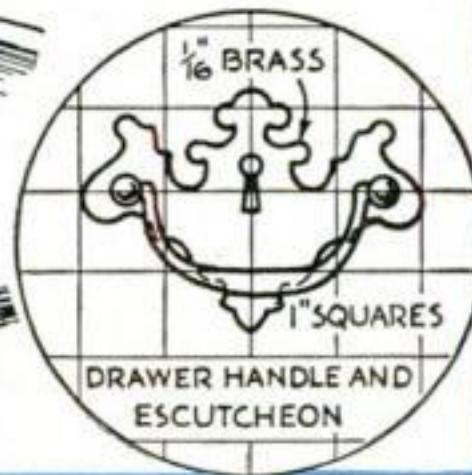


The drawer fronts and sides should be carefully dovetailed for the utmost durability

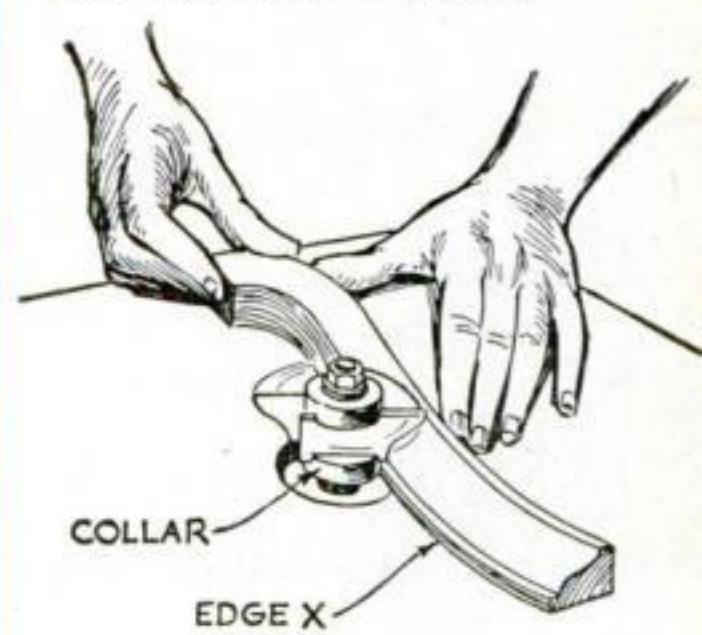
Utility and beauty are combined in this desk, which is a very much simplified version of the Governor Winthrop design



If the proper style of hardware is difficult to obtain, drawer-handle plates and escutcheons may be jig-sawed from brass



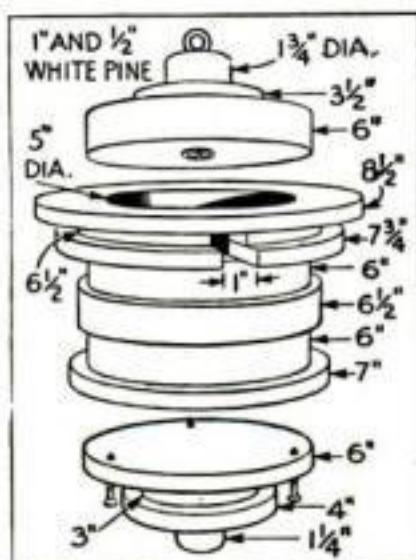
THE MOLDED SCROLL MAY BE SHAPED FREE-HAND AGAINST COLLAR





Modernistic Wren House Built Up in Layers

THIS little hanging house for wrens is built of horizontal sections of so-called 1" and $\frac{1}{2}$ " white pine, the actual thicknesses of which are about $\frac{7}{8}$ " and $\frac{7}{16}$ ". The seven middle sections are cut out to form the cavity, and a 1" square entrance is cut through two hollow sections as shown. The disk that forms the floor is fastened with short screws so that it may be removed for cleaning, but the other sections are held together with long slender brads. Give the completed project two coats of outside white paint.—HAZEL F. SHOWALTER.



Riveting Parts Lightly

Two parts sometimes have to be riveted together lightly so that they will pivot on the rivet as if it were a hinge. This can be done with the aid of a piece of shim stock

in the end of which a slot has been cut. Slip this around the rivet between the two parts to be connected, hammer over the rivet until there is no lost motion, and then remove the shim.—S. J. GANCHER.



Window Lock Is Secured with a Thumbscrew

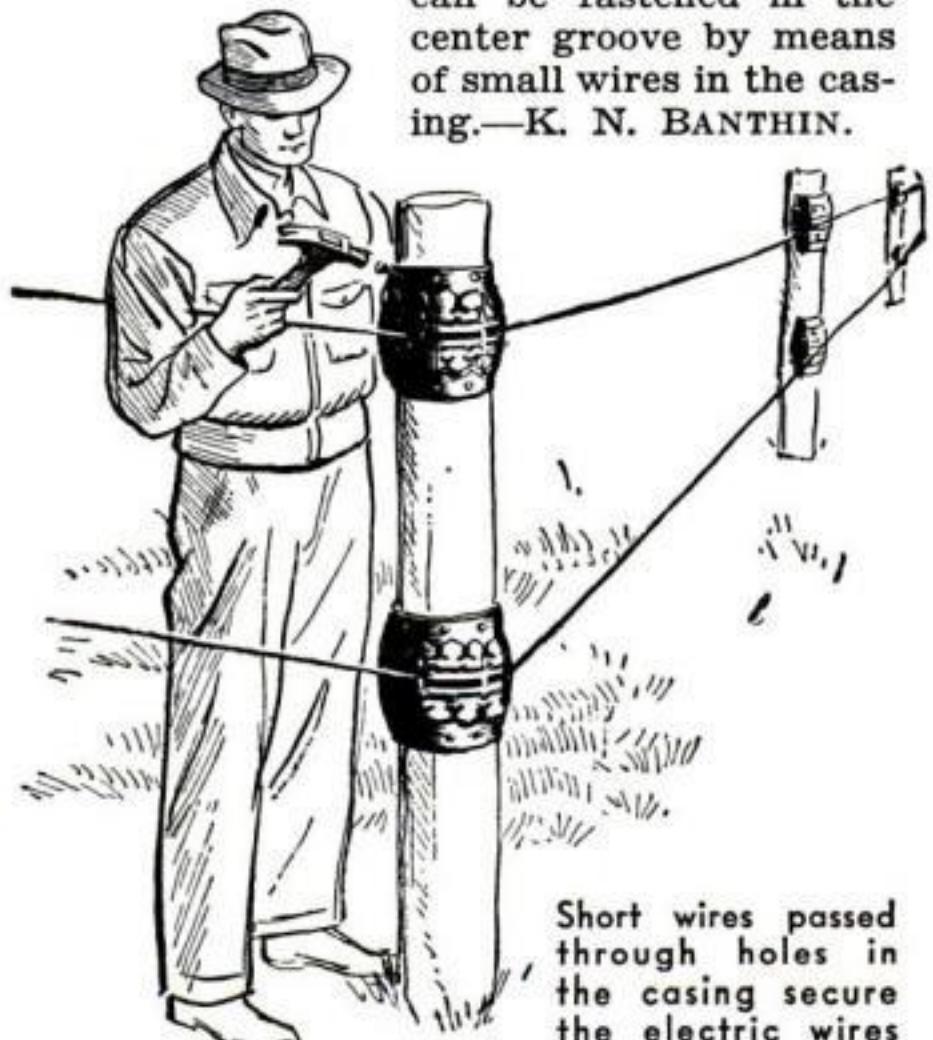
THE type of sash lock often used for opened windows, which consists of a rubber-tipped bar hinged to a plate fastened to the upper part of the lower sash, can easily be made tamperproof. Drill and thread a hole $\frac{1}{4}$ " from the finger end of the hinged bar so as to receive a $\frac{3}{4}$ " by $\frac{3}{16}$ " brass thumbscrew. When tightened, the lock cannot be released by a bent rod from the outside.—A. M. C.



Screwing down the small thumbscrew wedges the rubber tip against the opposing window sash

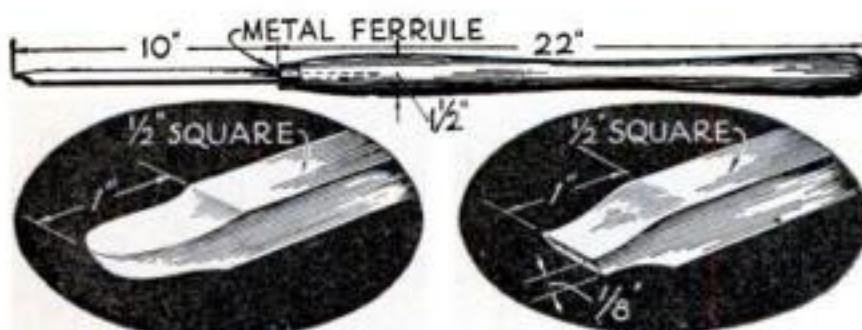
Unbreakable Insulators for Electric Fence

MANY owners of electric fences have had trouble with broken porcelain insulators, especially in the fence corners. These may be replaced with pieces of old automobile tire casing on which some of the grooving is still present. The bead is cut off all around the tire on both sides, and then the tire is cut up into sections from 6" to 9" long and nailed to the posts so that the wire can be fastened in the center groove by means of small wires in the casing.—K. N. BANTHIN.



Heavy Lathe Tools Bore Deeply into Wood

THE average wood-turning tool for end-grain boring in faceplatework is of comparatively thin stock and often chatters badly after it has cut several inches into the work. Tools of the type illustrated below, however, can be advanced into turnings as deep as 8" and will clean the wood out with remarkable speed and ease. They are made



Two types of tools. The bevel on the top of each is very shallow and extends back about 1"

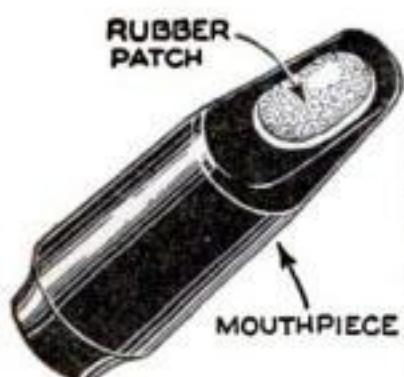
from square 14" files, which will finish up about $\frac{1}{2}$ " square when the teeth are ground off, or from $\frac{1}{2}$ " square tool steel. If made from a file, the tapered part of the file should be cut off, leaving the file approximately 10" long. One tool can be given a square point and the other a round point. The round-point tool requires somewhat more work in grinding. The underside is ground to the same angles as the square point. Hardwood handles, preferably maple, about 22" long (like the handles of metal-spinning tools) are finally added.—J. B. L.

Lemon Acts as an Emergency Soldering Flux

IF YOU run out of soldering flux, the juice of a lemon will serve the purpose reasonably well for small work. Merely rub a piece of lemon over the work, and then proceed with the soldering.—WILLIAM SWALLOW.



Tire Patch Pads Mouthpiece



AFTER having tried many methods of making a pad for my clarinet mouthpiece, I used a tire patch and found that it worked to perfection. It is applied to the mouthpiece as to a tire.—WILLIAM HART.

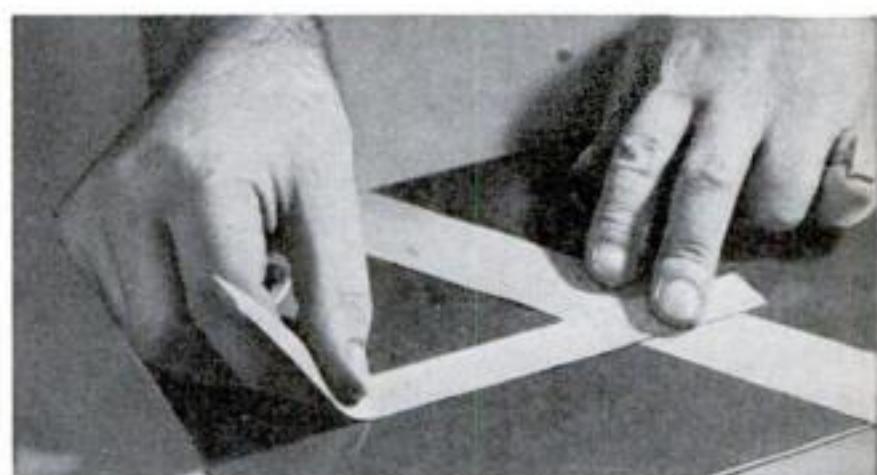


Shallow Concrete Forms Bent from Cardboard

FOR odd-shaped concrete forms not more than a few inches high, such as a circular foundation for a furnace, heavy corrugated cardboard from grocery boxes will serve satisfactorily. It bends easily and can be held in place with bricks or other heavy weights.—B. J. ZITEK.

Paper Tape Marks Metal Plainly for Sawing

WHEN a sheet of metal has to be cut on the scroll or band saw, the usual scribed or penciled guide lines are not always sufficiently legible to prevent errors. A distinctive guide that can be seen even in a dim light consists of a strip of gummed paper tape. The cuts are made along the edge.



The paper is stripped off after the cuts are made

... A NEW FUN-PROVOKING STUNT FOR PARTIES



By
JULIUS STEINBERG

tap, two 1.5-volt dry cells (connected in series), two cheap laboratory test prods, and an inexpensive milliammeter. A 0-15 milliammeter was employed for the detector shown, but one with higher readings is preferable because the readings are often near the 15-milliamper mark. A small rheostat can be placed in series with the milliammeter to reduce the readings, if preferred.

The parts may be mounted in any convenient way provided the connections are made as shown. It pays, however, to design the box or cabinet so as to look as impressive as possible for its psychological effect.

The 45 volts applied to the plate of the tube through the milliammeter are enough to produce a current reading of about 10 milliamperes. By holding one of the test prods in each hand, the subject connects the $22\frac{1}{2}$ -volt tap of the battery to the grid of the tube. As the pressure of the hands upon the test prods increases, the resistance at

The detector consists of a three-element radio tube, milliammeter, pair of cheap laboratory test prods, batteries, and case

WITH this homemade electric lie detector, you can mystify and entertain your friends by exposing falsehoods. Hundreds of tests by the writer have proved its meter to indicate correctly about eighty percent of the time, and that is sufficient to get a lot of laughs at any party.

The cost need not exceed \$2.50. A three-element radio tube (No. 45) is used in the circuit. The other parts required are a socket, 45-volt "B" battery with a $22\frac{1}{2}$ -volt

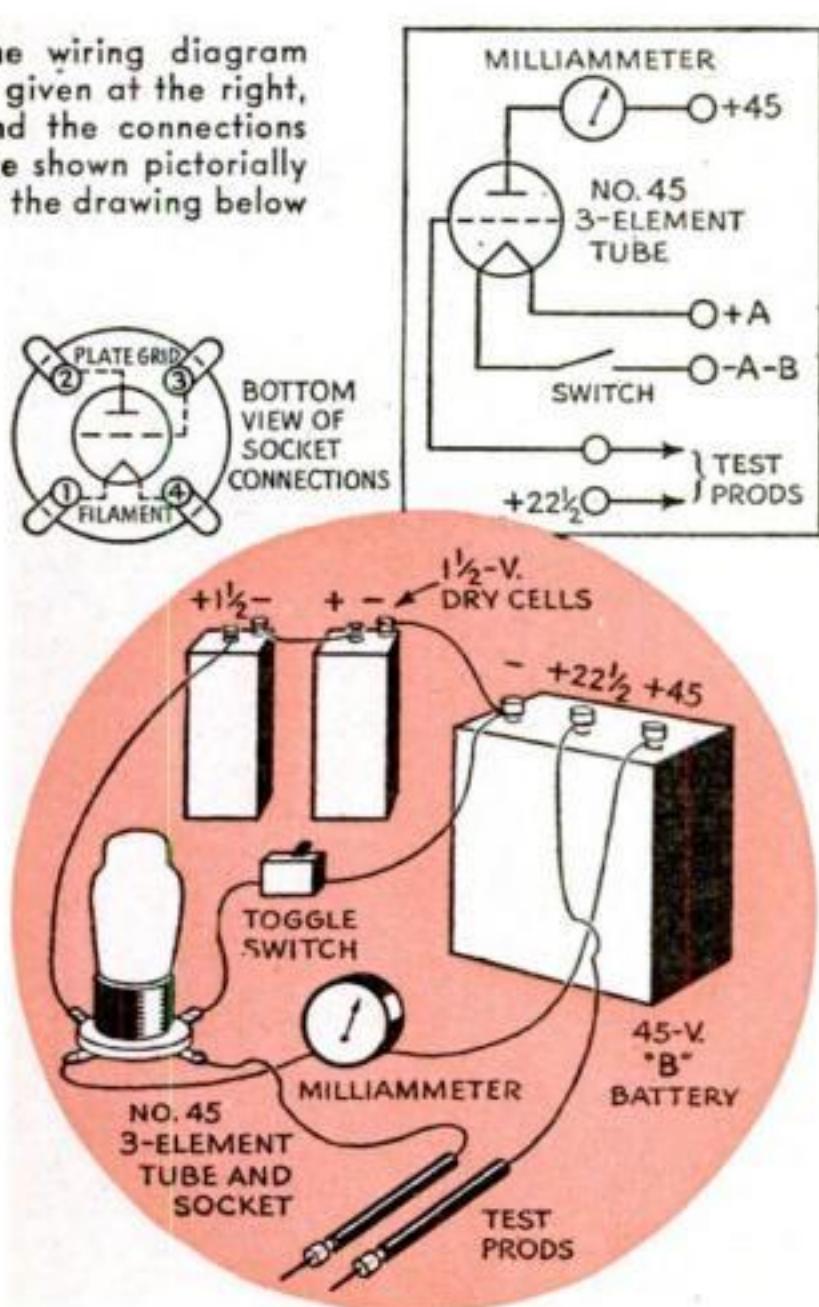
this point decreases, thus permitting a greater flow of grid voltage. This causes a higher milliamper reading, which indicates increased tension on the part of the subject.

Not the slightest hint as to how the detector works must be given to the person being tested. He or she should merely be instructed to hold the metal end of a test prod in each hand with a light, comfortable grip. The box should face the questioner so that the other person cannot see the reading of the milliammeter.

One way of using the device is to tell a man to write down the names of five girls, including that of his wife or sweetheart. He is then to answer "No" to each question, such as "Is it Ruth?", "Is it Grace?", and so on. Involuntarily he will grip the test prods tighter when he says "No" to the right name. Another idea is to have the subject hide an object somewhere in the house, unknown to you. Then name the different rooms to him and watch the dial as he says "No" to each question.

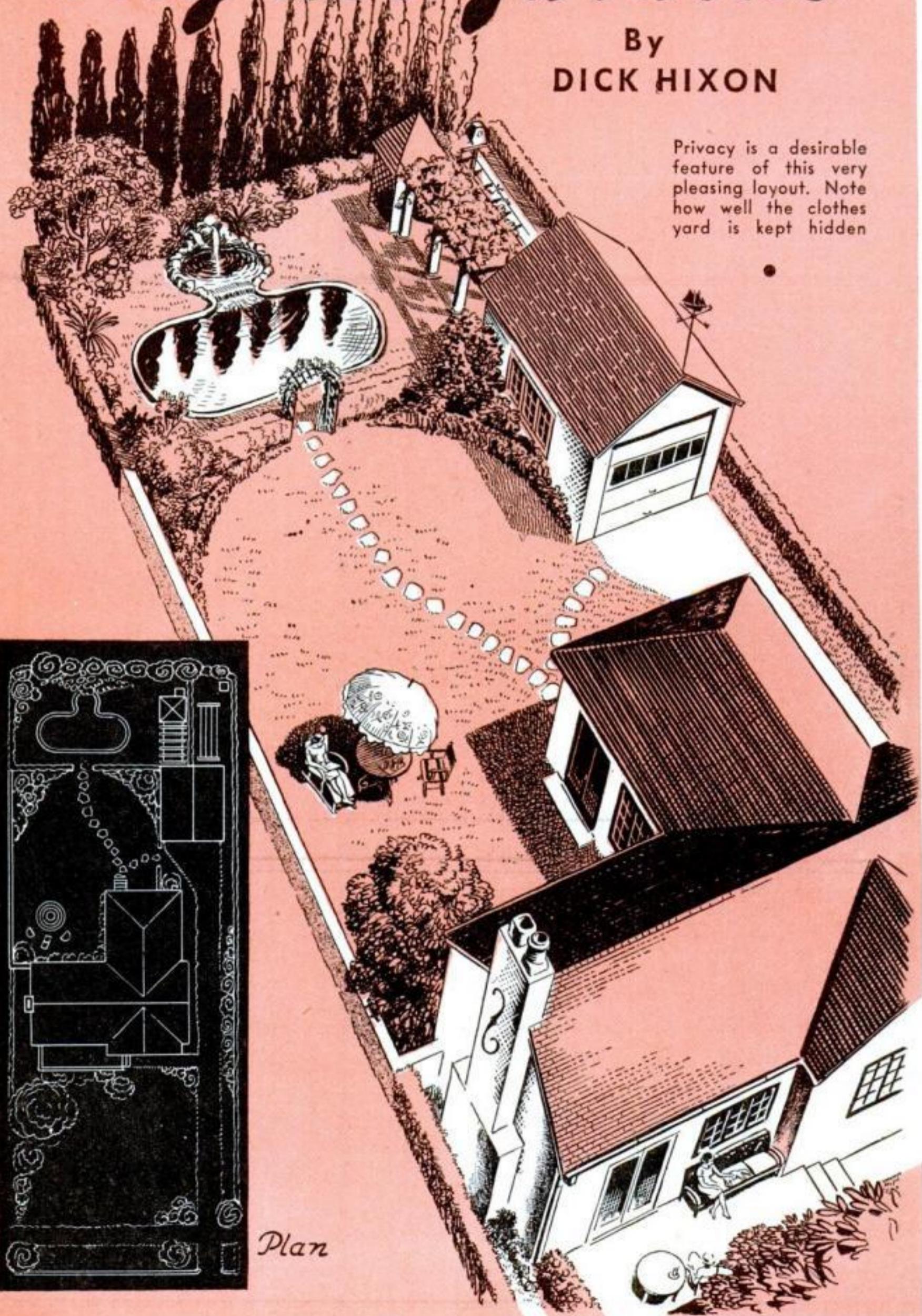
Other similar experiments can easily be devised. Bear in mind that the questions should be planned in advance and asked fairly rapidly so as to catch the subject unawares and startle him sufficiently to make him grip the prods tighter in his effort to control himself and lie convincingly.

The wiring diagram is given at the right, and the connections are shown pictorially in the drawing below

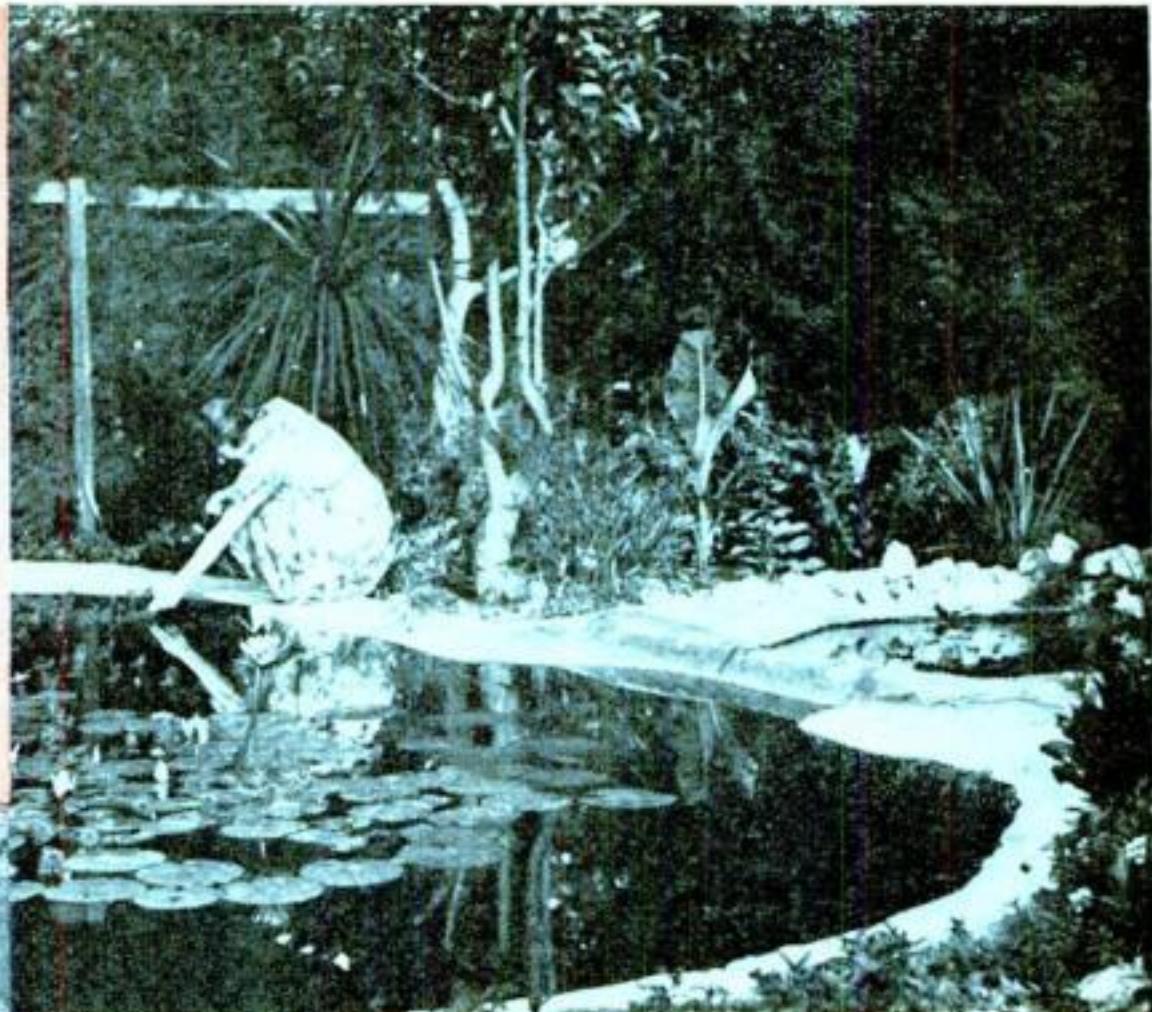
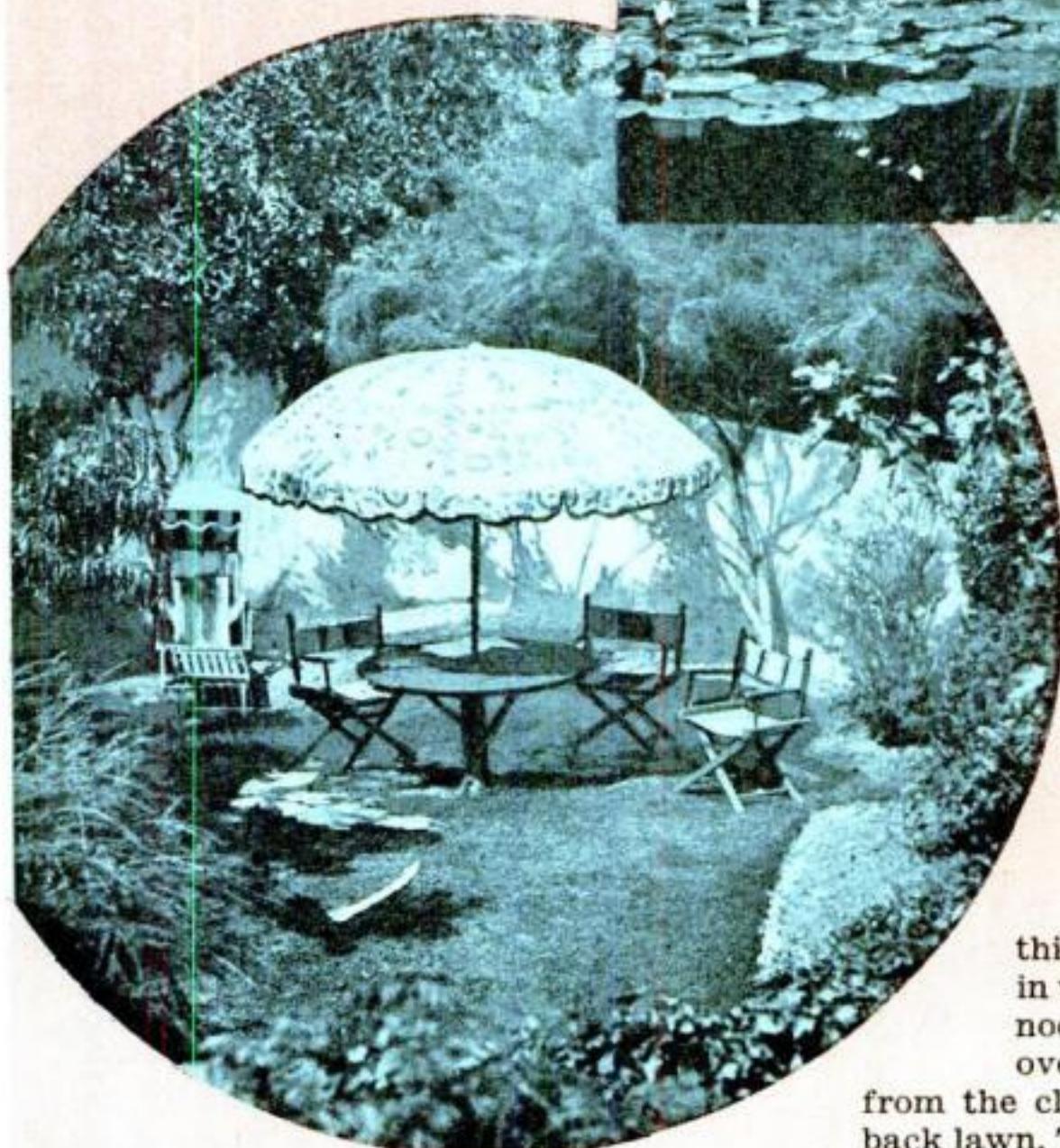


City-Lot Gardens

By
DICK HIXON



**BY MAKING YOUR
PLANS CAREFULLY
YOU CAN HAVE A
LITTLE COUNTRY
ESTATE IN BACK
OF YOUR HOME**



The fishpond and aquatic garden, fed from a waterfall. At left is a corner of the walled-in lawn

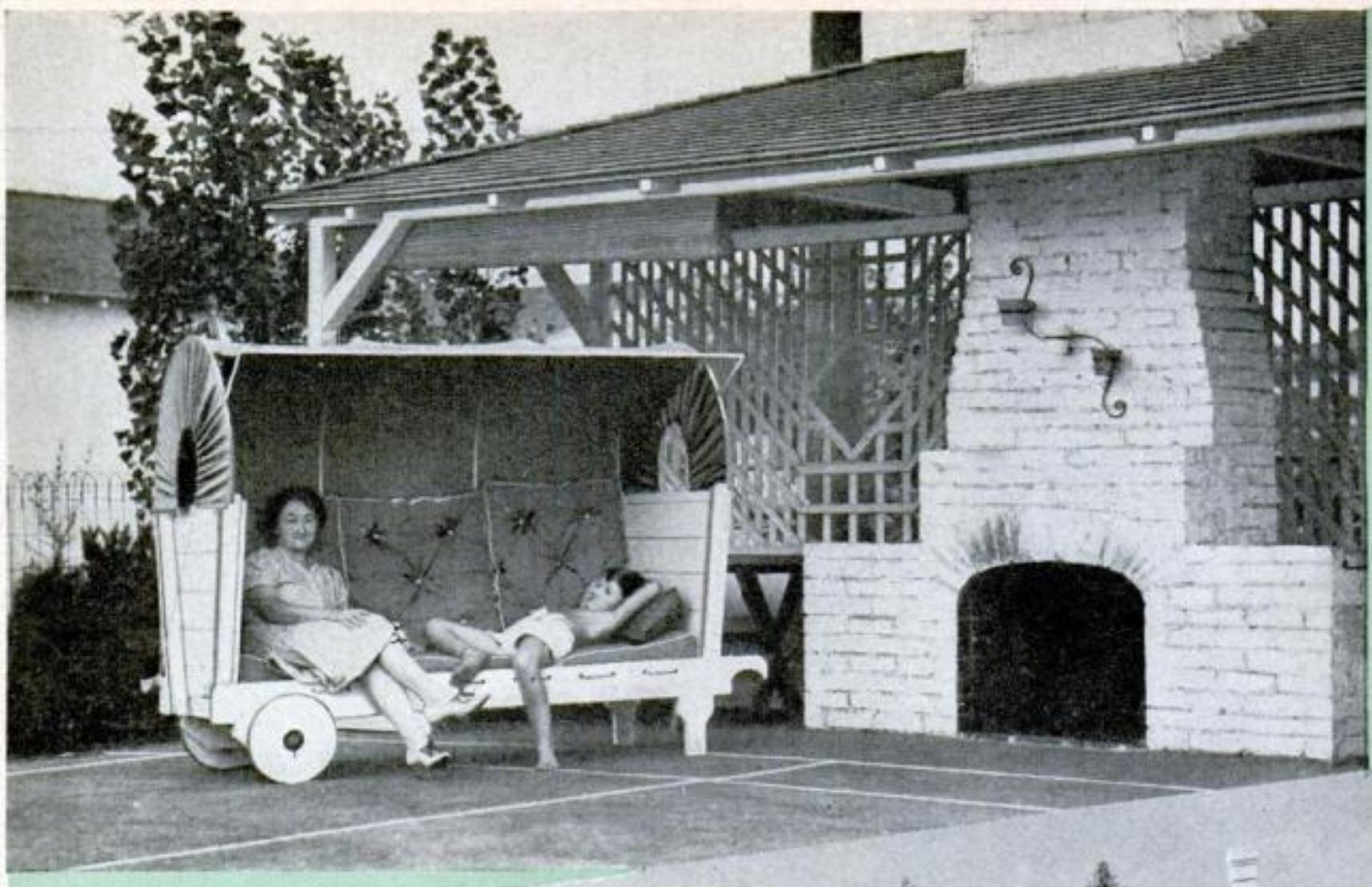
ground and included a pool large enough for them to learn to swim in. As they outgrew this, the pool was given over to aquatic plants as illustrated above. A waterfall and rock garden were added, soil was filled in over the original gravel, and shrubs set out. With an aviary and a pergola, this section makes a delightful spot in which to spend a summer afternoon. Six-foot chicken-wire fences overgrown with ivy separate it from the clothes yard and the rest of the back lawn. The lawn has a curving flagstone walk and is set off by flowers and shrubs, the focal point being the arched gateway.

The second plot layout is that of the recently completed home of E. A. Carrington, San Gabriel, Calif. It is admirably landscaped and worthy of careful study. Not only is the general arrangement harmonious, but the individual details are of the most appealing type. Note that the shrubbery in front is so disposed that it does not cut off light nor obstruct the view of the house from the street.

At the rear of the lot room has been found for a badminton court, a covered patio complete with barbecue fireplace and

CAREFUL planning makes it possible to include many desirable garden features in an average city lot without crowding. Two layouts are illustrated that could be adapted in part or in whole to almost any property.

On the facing page is a bird's-eye view and plan of a garden of especial appeal to those who like privacy. In landscaping this place, which is in Pasadena, Calif., the owner first planted a cypress hedge on three sides, partly supplemented by a stucco wall. The extreme rear of the lot was then prepared for a children's play-



Sheltered patio and fireplace. The latter has an incinerator at the back. It is placed at the end of the badminton court (see layout opposite)



Trees and shrubbery are spaced so as not to obstruct the view of the house. At left, flowering annuals improve the rear veranda

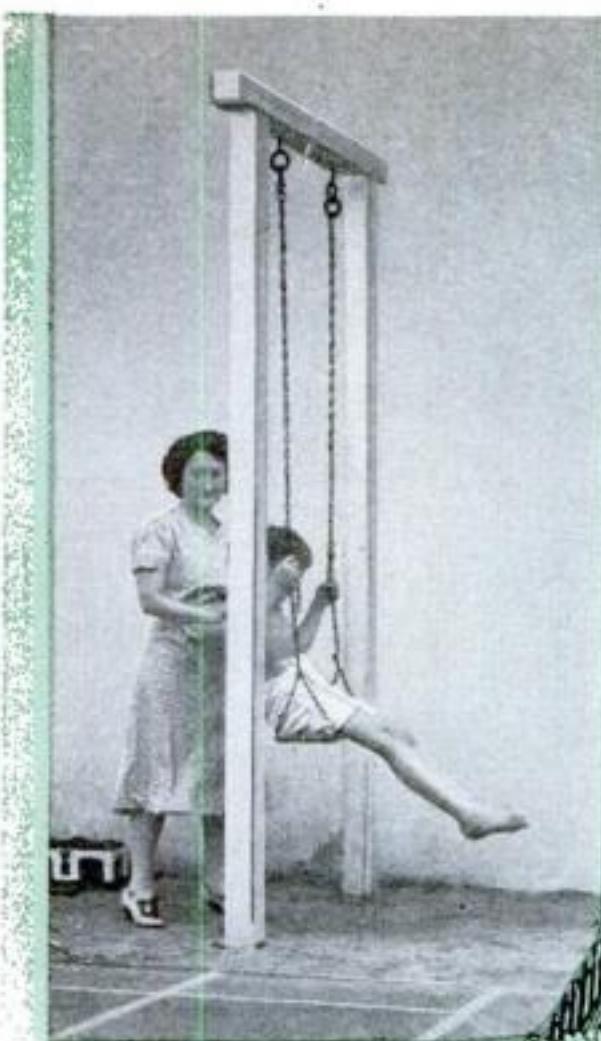


incinerator, and a railed-in space for a picnic table and benches. In front of the court is a 10' wide cement area upon which tricycles and wheel toys can be used. Directly behind the garage, a long sand-box occupies otherwise unused space, and a swing is erected here. Clotheslines are stretched across one end of the badm-

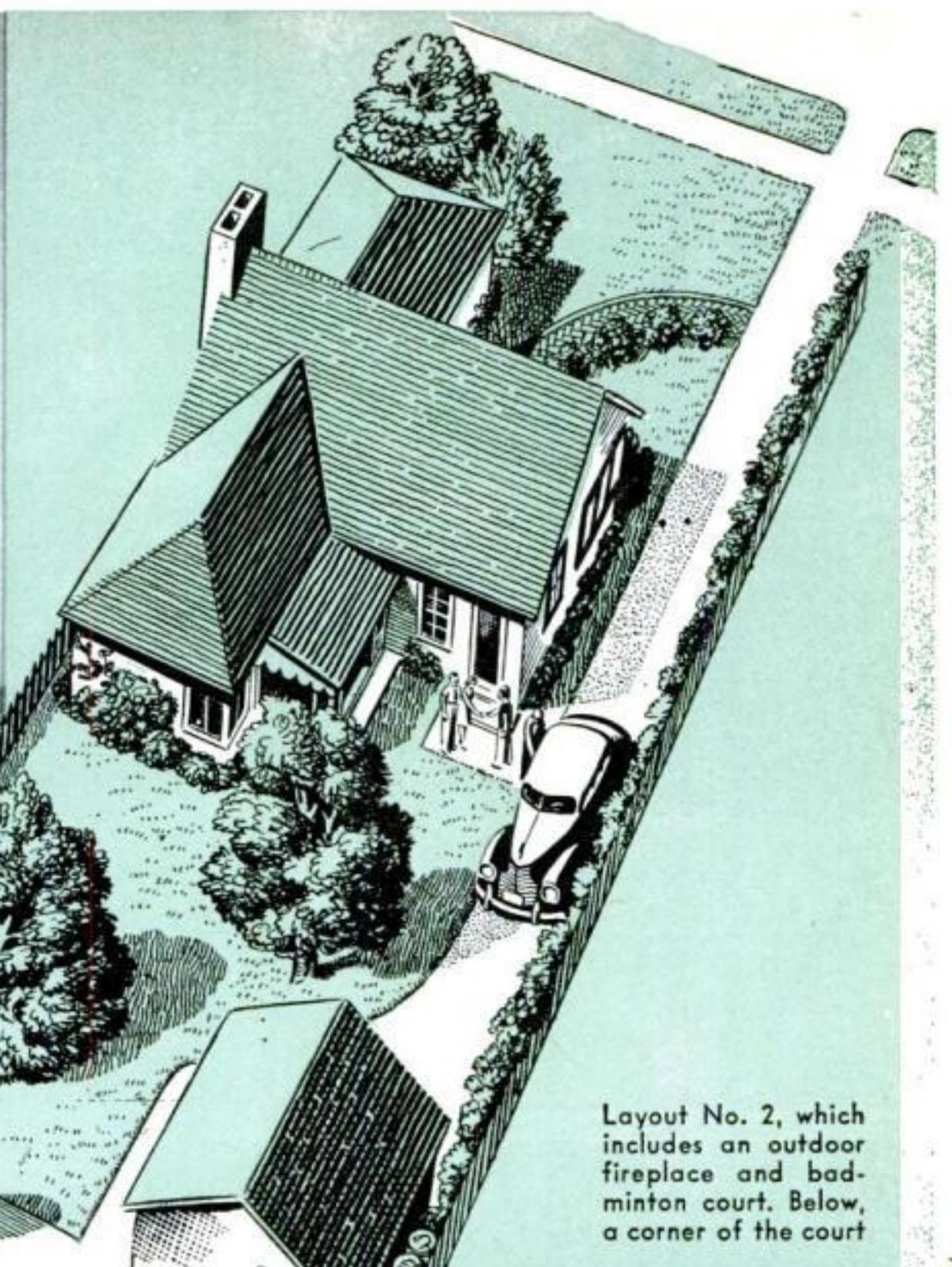
ton court when required, but the posts do not interfere with play.

Large shade trees are confined to the back yard. A white picket fence incloses the yard, and flowering annuals along the fence present a lively and inviting color scheme.

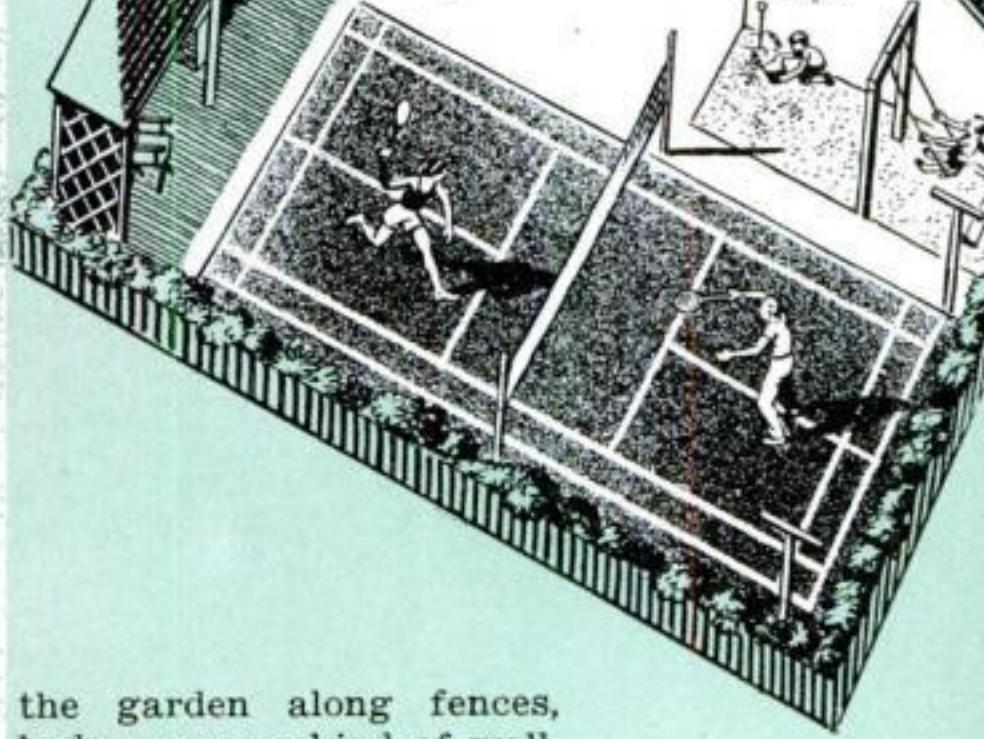
In locating trees and shrubs, it is a good plan to keep them well toward the edges of the lawn instead of setting any in the middle, which tends to give a cluttered-up impression. And shrubs should be selected with an eye to variety in leaf tones. A clump of them, if all of the same shade of green, becomes monotonous unless they are flowering, in which case harmony of blossom should be taken into consideration. This also applies to flowering annuals in



The swing is set up in a sand-box for the children



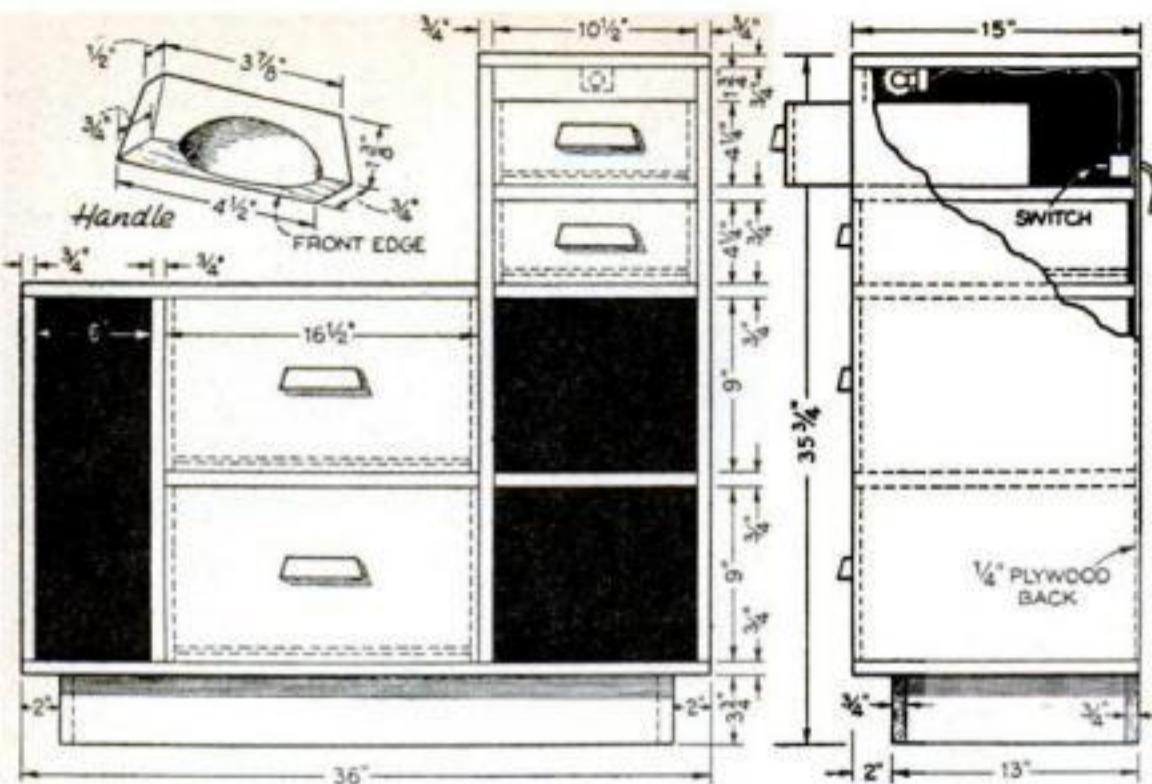
Layout No. 2, which includes an outdoor fireplace and badminton court. Below, a corner of the court



the garden along fences, hedge, or any kind of wall.

Note that in the layout above, the rubbish cans are placed between the garage and the fence, and the clothesline is behind the garage, so that it cannot be seen from the street or from the house. A small swimming pool might be substituted for the badminton court.





Bedside Stand

EQUIPPED WITH
AUTOMATIC
NIGHT LIGHT



WHEN the upper drawer of this combination night table, bookstand, and cabinet is opened, a small electric lamp is automatically switched on and illuminates the room softly. There is not sufficient light to awaken even the lightest sleeper, yet enough is thrown upward from the open drawer to make objects visible anywhere in the room.

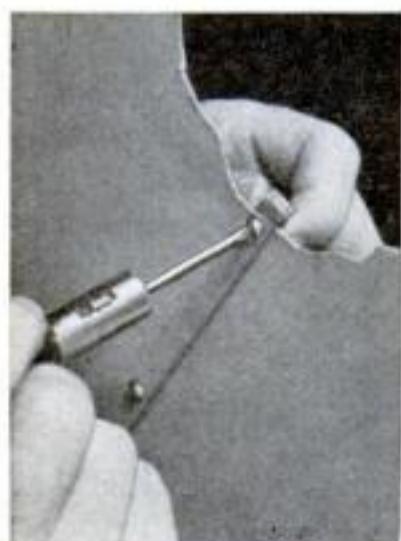
The cabinet is made entirely of white pine doweled and screwed together with the exception of the back panel and the drawer bottoms, which are $\frac{1}{4}$ " three-ply Douglas fir. The finished piece is painted cream and trimmed with light blue, but any color scheme could be used.

Back of the top drawer is placed the switch used to control the light. For safety, an inclosed closet-door switch of approved type should be used. The drawer is made of such a length that it will shut off the switch

when pushed all the way in. A suitable catch can be provided to hold the drawer shut. The lamp socket is mounted on a block of wood under the top of the cabinet near the front of the drawer.—WILLIAM G. AUTENRIETH.

Fastening Thin Sheets with Wood Screws

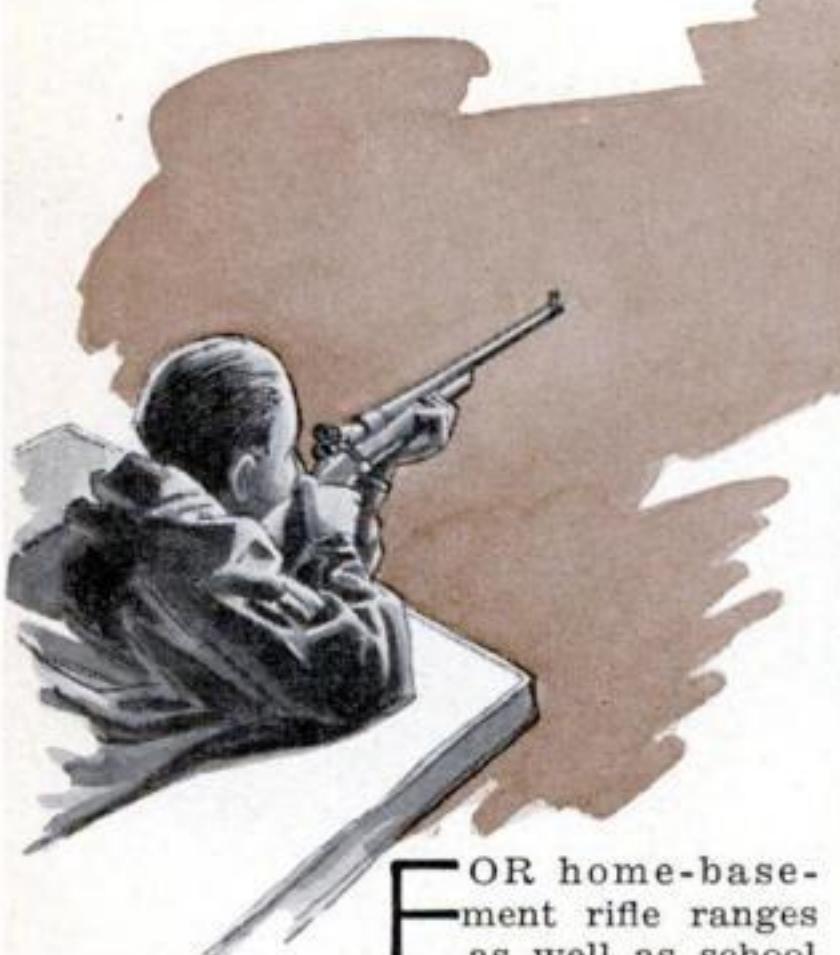
TEMPORARY or even permanent models and other projects made of sheet materials, such as fiber board or thin metal, may be assembled with small wood screws by the method illustrated in the photo at left. The screws pass through the material into small pieces of tough sole leather, which give the threads a good grip. It is astonishing the strength this fastening has when good leather is used.



How to Fix Broken Base of Graduate

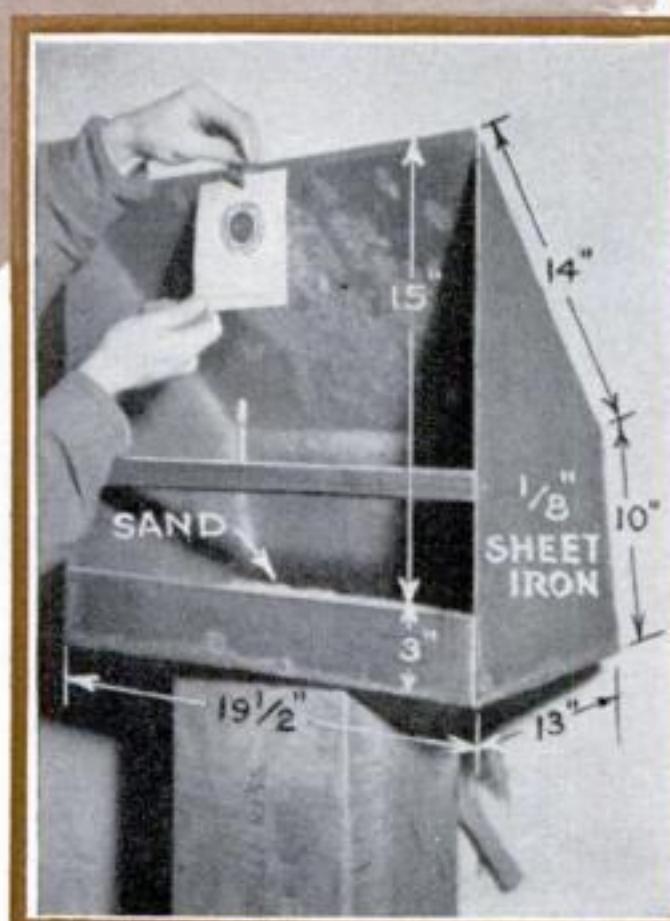
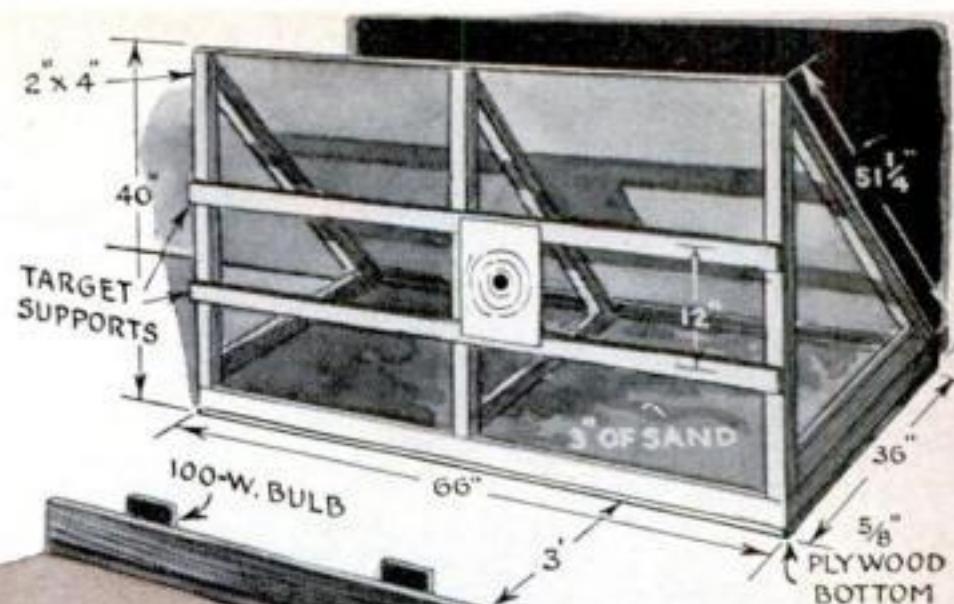
THE standard laboratory-type glass graduate occasionally is rendered useless by breaking off the foot. To repair it, get a rubber door-knob cover, mix a small quantity of patching plaster with water, fill the cover with the plaster, and before it sets, push the broken end of the graduate into the plaster. Let it set overnight to dry.—PAUL BAUER.

SAFE, DURABLE Backstops FOR INDOOR Rifle Ranges



FOR home-base-
ment rifle ranges
as well as school
and club ranges, good backstops may
be constructed as shown. The smaller,
portable one is for individual use. It
is riveted or welded together and
painted. An object bar holds what-
ever you wish to shoot at, and targets
are hung from the wire hook at the
top. The backstop is set at shoulder
height so the deflection angle is right,
and sand is placed in the bottom to
kill all lead splatter.

The larger backstop is for school or



METHOD OF MOUNTING BACKSTOP

The bullets
are deflected
downward in-
to the sand

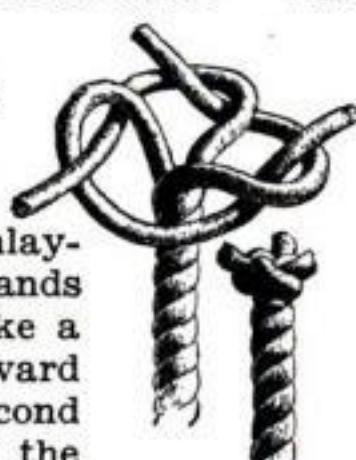


PATH OF BULLETS

The portable backstop is sheet iron about $\frac{1}{8}$ " thick,
and the large one is backed with $\frac{3}{16}$ " or heavier plate

church teams. Members of one church team made
money by running a gallery at so much a shot.
For targets they used three bushels of cracked
glassware from the local "five-and-ten," a lot of
burned-out electric-light bulbs and radio tubes
from an electrician, and a supply of thin, hard
wafer candies.—BRUCE MACINTOSH.

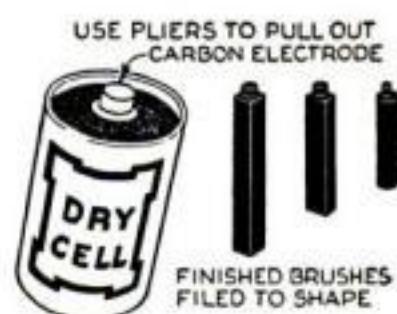
Preventing a Rope from Unlaying



TO KEEP a rope from unlaying, separate the three strands for a few inches and make a loop of one with the end toward the right. Loop the second strand under and around the end of the first. The third strand then goes under and around the second, and finally the end of the third is passed through the loop of the first.—W. H. F.

Brushes for Small Motors

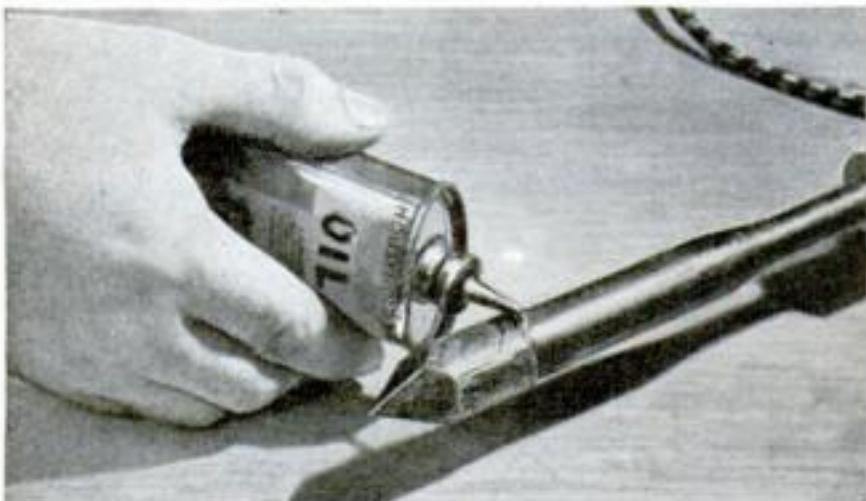
NEW brushes for small electric motors,
such as those used on vacuum sweepers,
sewing machines, grinders, and the like, can
quickly be made from the carbon electrodes
of used flash-light
batteries. Clamp
each carbon lightly
in a vise, file to the
required shape, cut
off, and form the
end to fit the spring.
—GRANT O. LOADER.





Cardboard Box Shields Blowtorch from Wind

A WINDBREAK for a blowtorch is easily made from a cardboard grocery carton by cutting off one end as shown.—B. J. ZITEK.



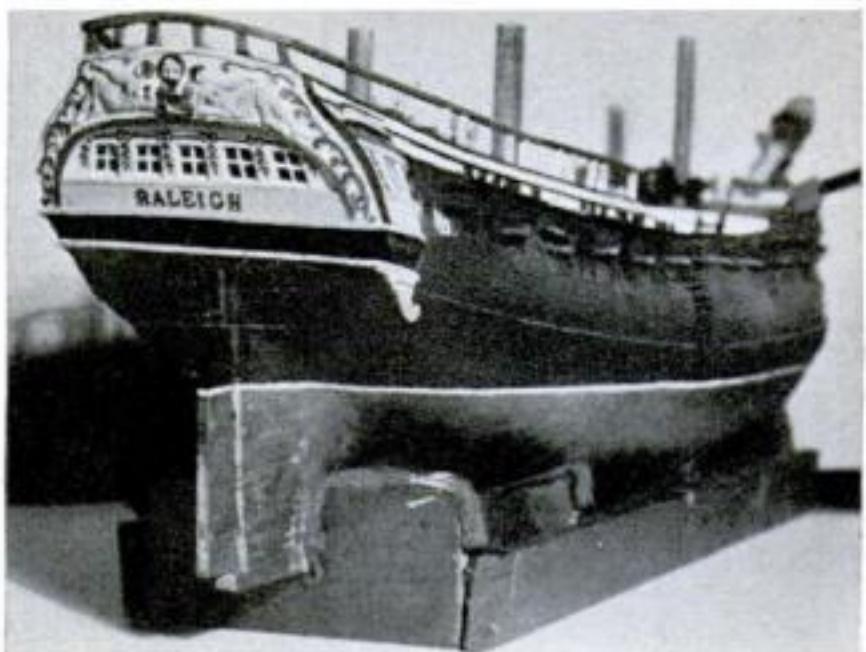
Loosening Corroded Tip of a Soldering Iron

IF THE tip of an electric soldering iron becomes so corroded that it cannot be removed, apply light machine oil around the threads. Allow the oil to penetrate, then turn on the current. As soon as the iron becomes warm enough to cause the oil to smoke, grasp the tip with pliers and unscrew.

TO MAKE a soldering paste, gently heat 4 parts tallow, 5 parts olive oil, and $2\frac{1}{2}$ parts rosin. While it is cooling, stir in $1\frac{1}{4}$ parts sal ammoniac. Beat to a paste.

Alphabet Macaroni Used for Ship-Model Names

SMALL alphabet macaroni sold for use in soups will sometimes serve effectively for the name of a ship model. Select the necessary letters, taking care to have them all regular in shape and size. Paint them first the same color as the surface to which they are to be applied. When thoroughly dry, paint the face of each letter to contrast with the hull. Then cement them carefully on the stern.—M. H. OSTERBERG.



This method eliminates the tedious task of lettering by hand, and the name stands out in relief

Old Distributor Cap Holds Cut Flowers

A NEAT "frog" or holder for cut flowers may be made from a distributor cap taken from an old automobile. Black caps are particularly good for use with all kinds of flowers. The holes are drilled through with a $5/16$ " bit so that the flower stems can extend through to the water in the bowl, as shown. Clean the distributor cap, of course, before using it.—B. B.

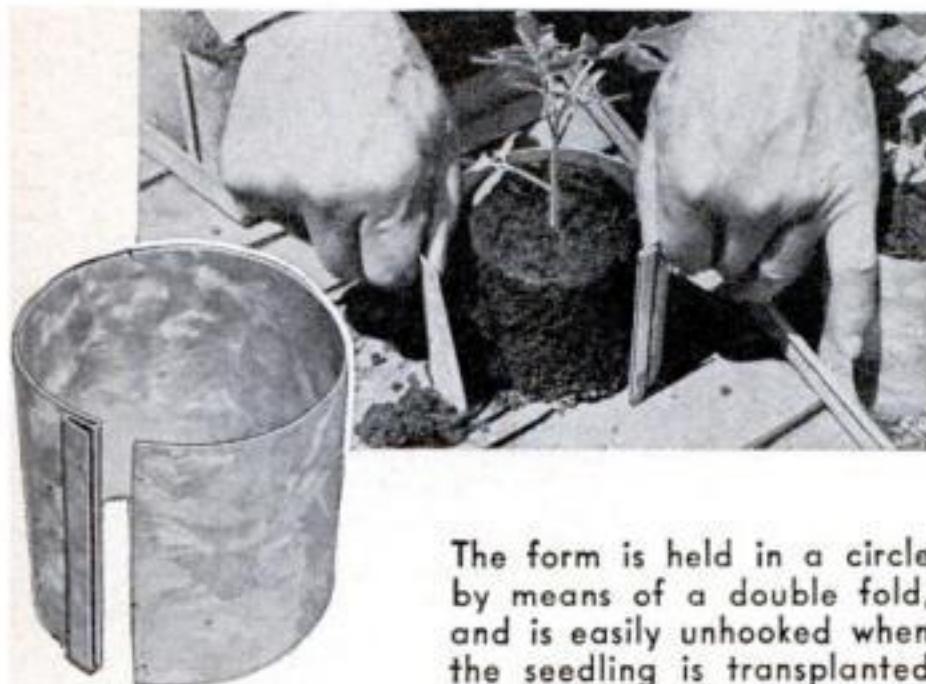


Convenient Metal Forms for Starting Tomatoes

INEXPENSIVE forms for starting tomato plants can be made in a short time by any tinner from scraps of sheet metal. The forms may be nested in a small space for storage and used year after year.

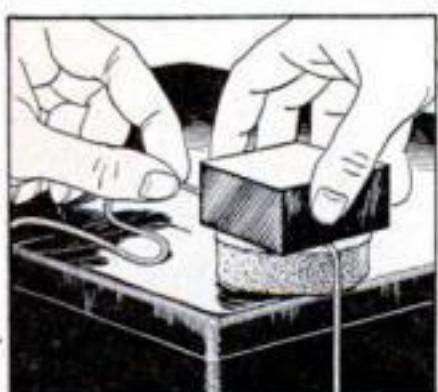
Each form requires a strip $2\frac{1}{2}$ " by 9". A double fold is bent at one end, as shown, and the folds are pressed sufficiently to engage the opposite end, thus forming a circle. The forms are set in shallow trays, an inch of gravel placed in the bottom of each form, and it is then filled with earth, in which seed is planted. Moisture is supplied by running water into the trays.

At transplanting time the roots are undisturbed, for the ring is simply opened and the earth-packed roots set into a hole.—B. N.



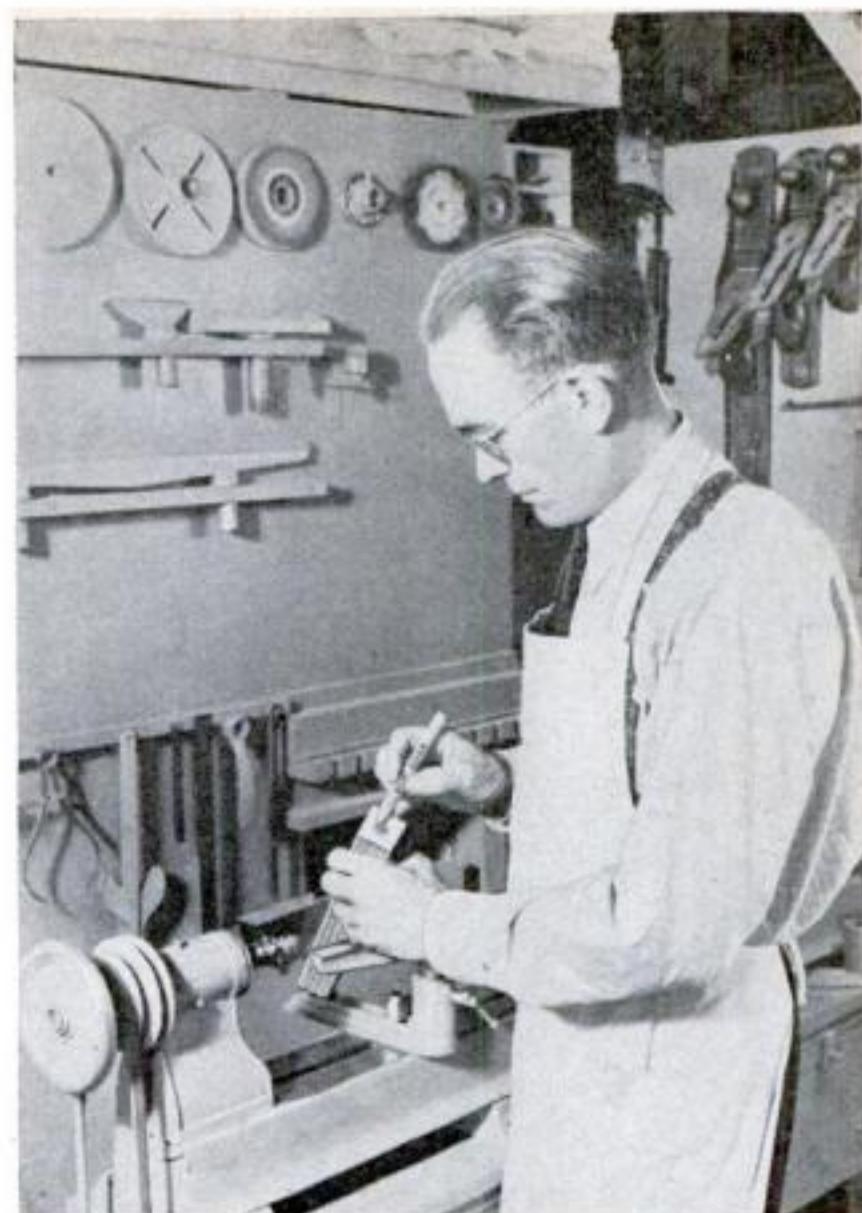
The form is held in a circle by means of a double fold, and is easily unhooked when the seedling is transplanted

Dropping a Plumb Line from a Metal Surface



Sponge rubber and a weight hold the line

place the cord on it, and set any fairly heavy object on top. A plumb bob of considerable weight can be held in this way and instantly adjusted in position or length. A piece of the material should be kept in the tool kit for just such emergencies.—FRANK BENTLEY.



Stick Lubricant Applied to Wood Turnings

A GRAPHITE surface lubricant made especially for eliminating squeaks on automobile hood lacings, door bumpers, and window channels is also a lasting and nonstaining lubricant for the tailstock center of wood lathes. It comes in stick form and is applied to the end of turning after the work has revolved for a minute or so. Unlike an oil or grease, it will not discolor the wood, and one application is sufficient for any length of turning.—H. F.

Bolts and Nuts Stored in Cans

THE two-part cans in which amateur photographers' prepared developers are packed make good containers for small nuts and bolts. The inner can is used to hold the nuts; the larger one accommodates the bolts.

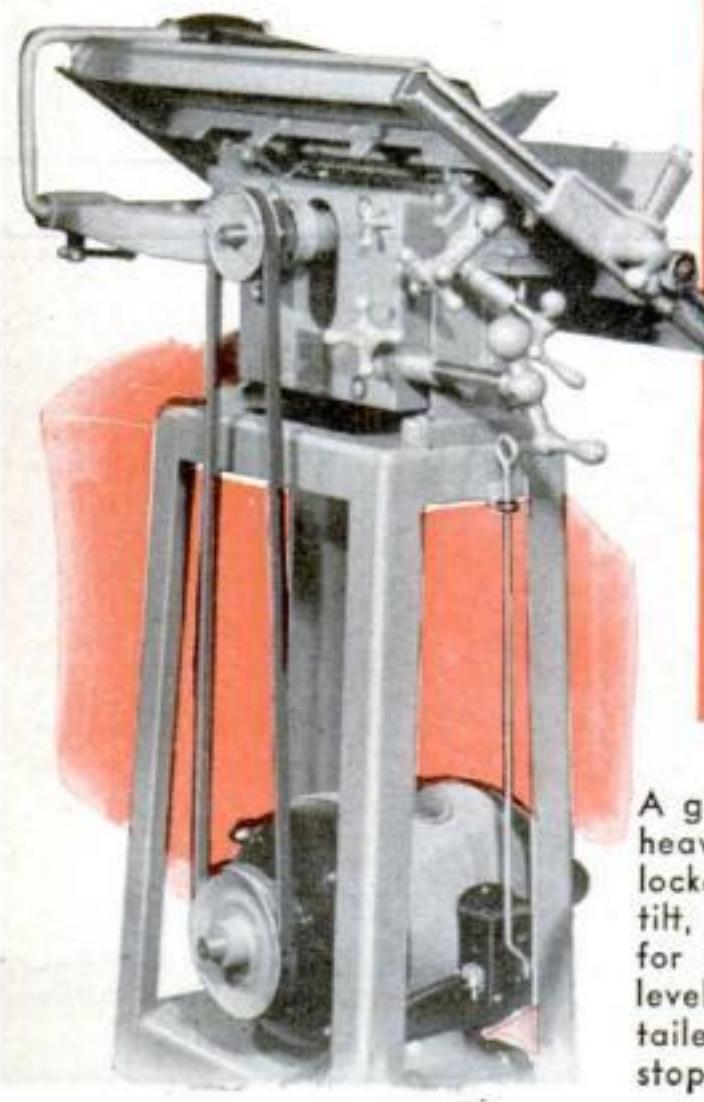


What You Should Know About

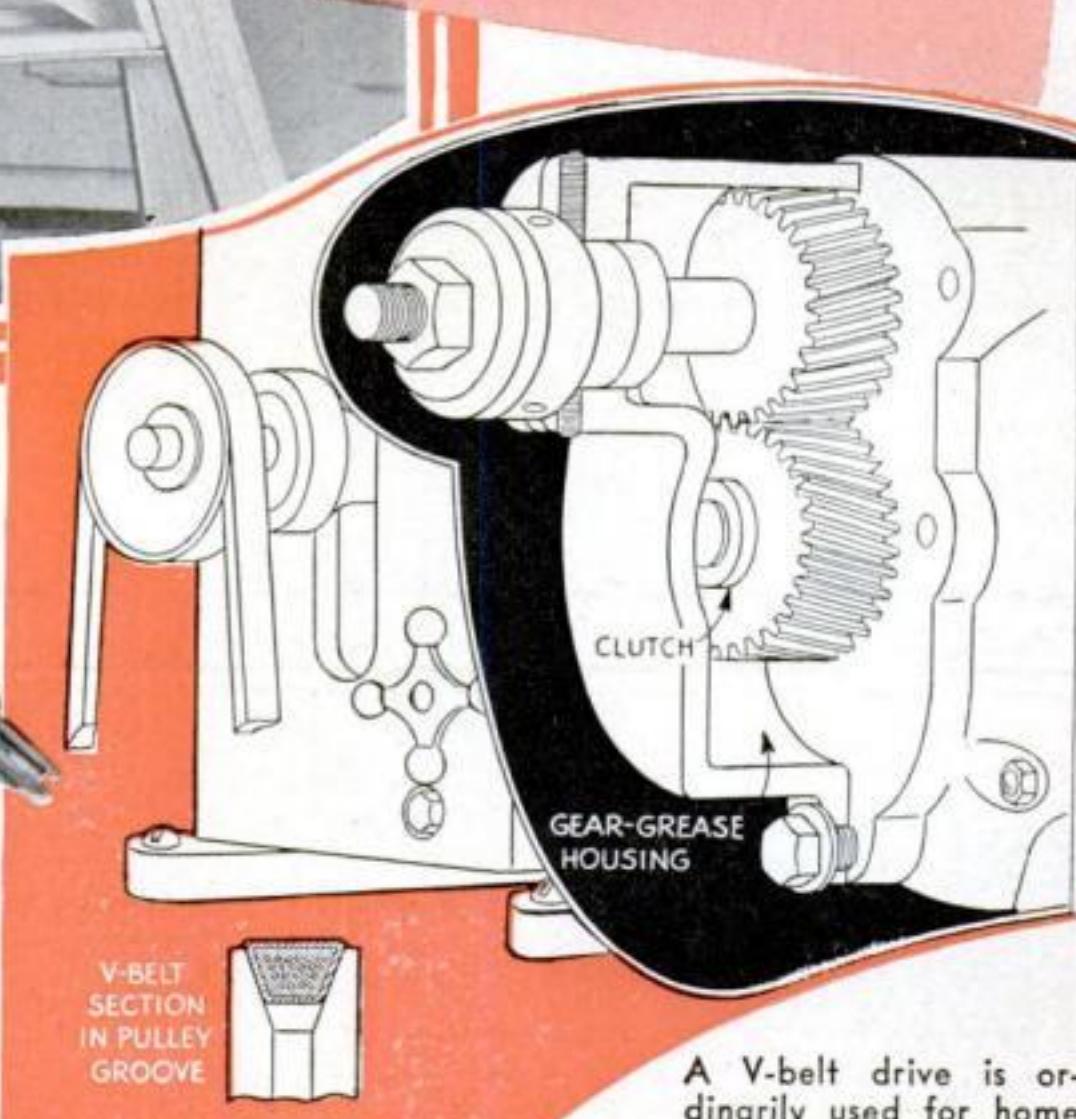
By
EDWIN M. LOVE



Robert Jaacks is impatiently awaiting the arrival of the circular saw, jointer, and scroll saw he ordered. After completing his workbench and tool cabinet, he added more lining to the walls of his shop and has just made two sawhorses. He is also studying catalogues and acquainting himself with the features of various woodworking machines.



A good tilt-table saw. Note the heavily-braced table, the well-locked trunnions, the worm gear tilt, and the adjustable stop pin for bringing the table back to level. The table rises on dovetailed ways. The miter gauge has stops for square and miter cuts



A V-belt drive is ordinarily used for home workshop saws, but in some cases a direct drive or silent gears

**PART V OF A
NEW SERIES
FOR BEGINNERS**

WOODWORKING MACHINES

HOME WORKSHOP machines have been improved year by year. Their convenience, durability, and general "foolishness" are little short of marvelous. Trouble-free bearings are displacing ordinary bronze bearings, and cast iron or steel is eliminating die castings for frame parts where strength and rigidity are essential. Ingenious quick-clamping devices save time in setting up and doing the work. Some of the more important constructional details to be considered when purchasing machines are discussed in the following questions and answers:

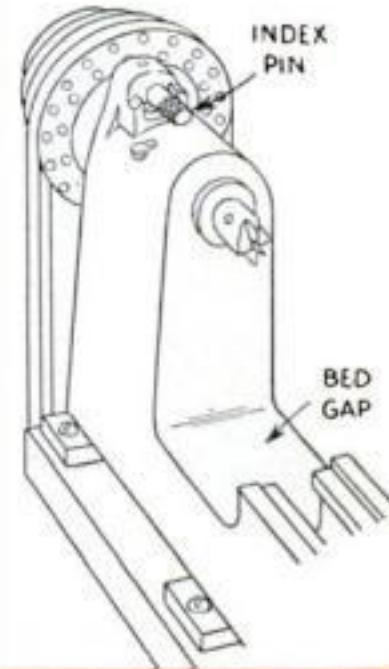
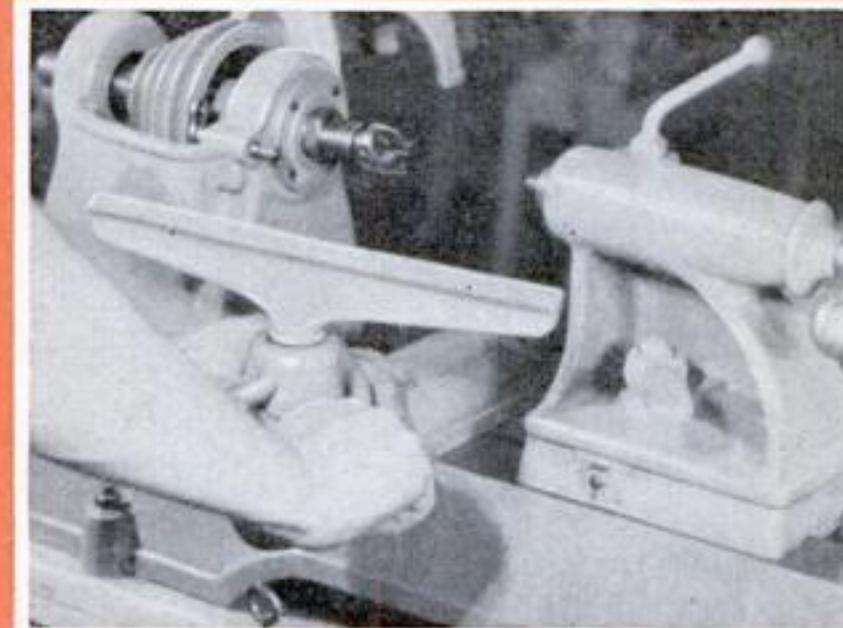
What size should a circular saw be?

Most home mechanics need a machine that will cut stock 2" thick, which calls for an 8" blade.

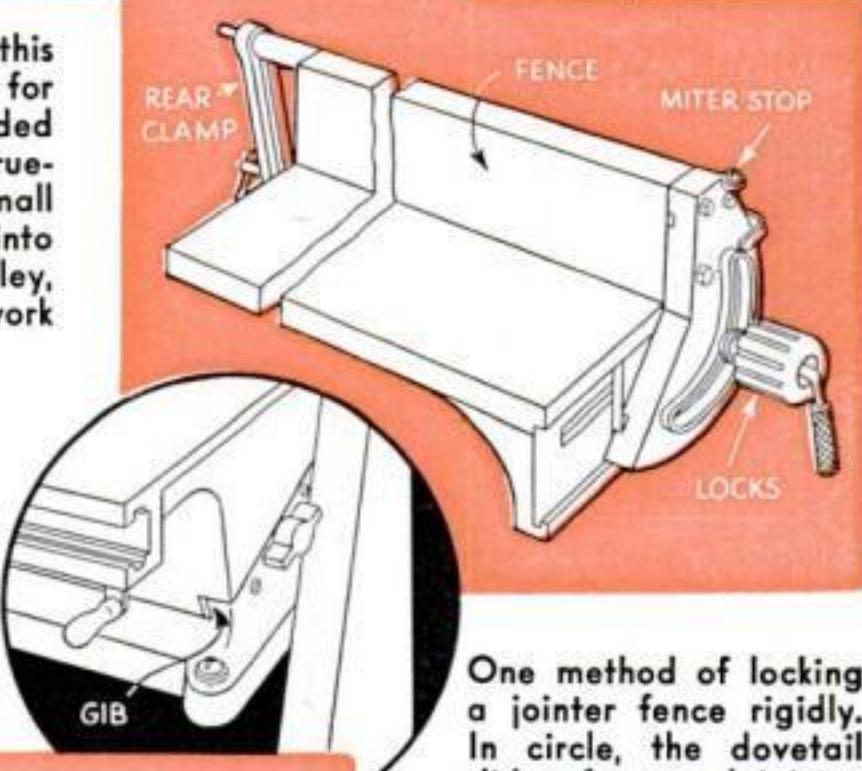
If much cutting of heavier lumber is expected, a 10" saw is indicated, and this size is required for beveling 2" material.

Table size is important. If there is less than 12" between the front edge and the blade, it is hard to use the miter gauge for cutting through a board 12" wide. To save

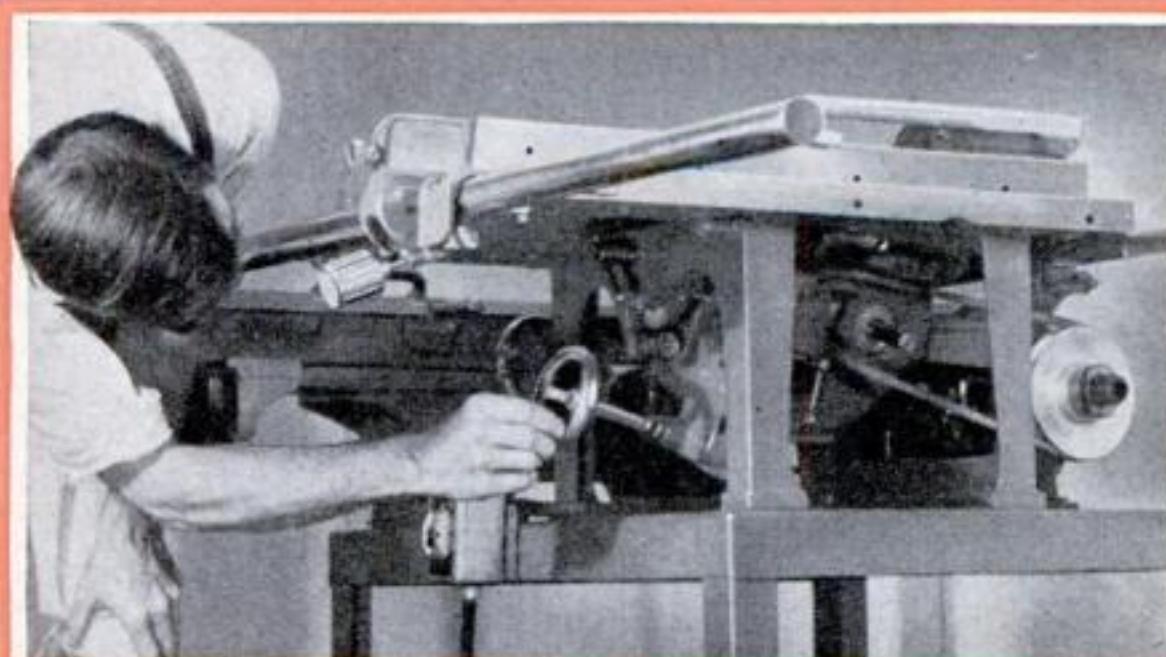
cost, however, some manufacturers furnish a medium table suitable for short work, and offer at a moderate price an extension to be bolted to the front of the table. In some cases side wings are added. A favorite



The massive headstock of this lathe is strong enough for metal spinning. Preloaded ball bearings insure a true-running spindle. The small index pin, which slides into chosen holes in the pulley, is used for dividing work

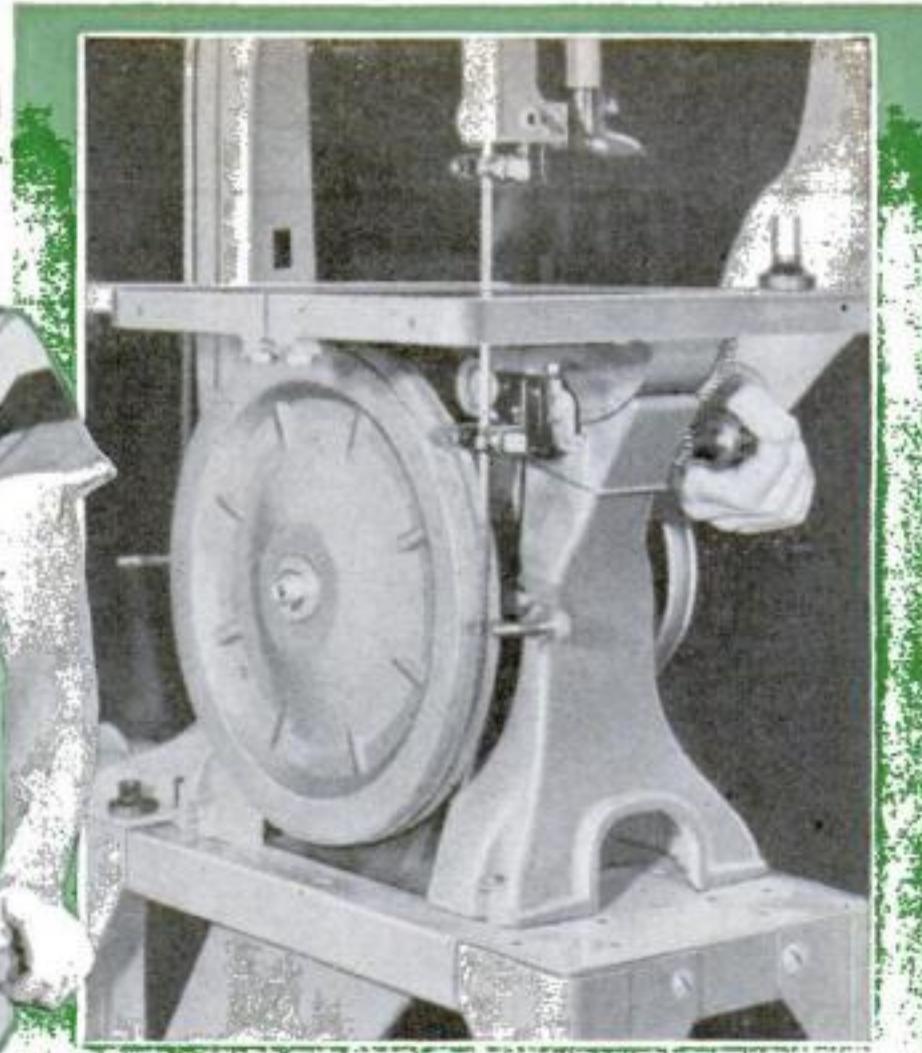


One method of locking a jointer fence rigidly. In circle, the dovetail slide of a good jointer table with an adjustable strip or gib to take up wear. The two screws indicated are for adjusting the gib

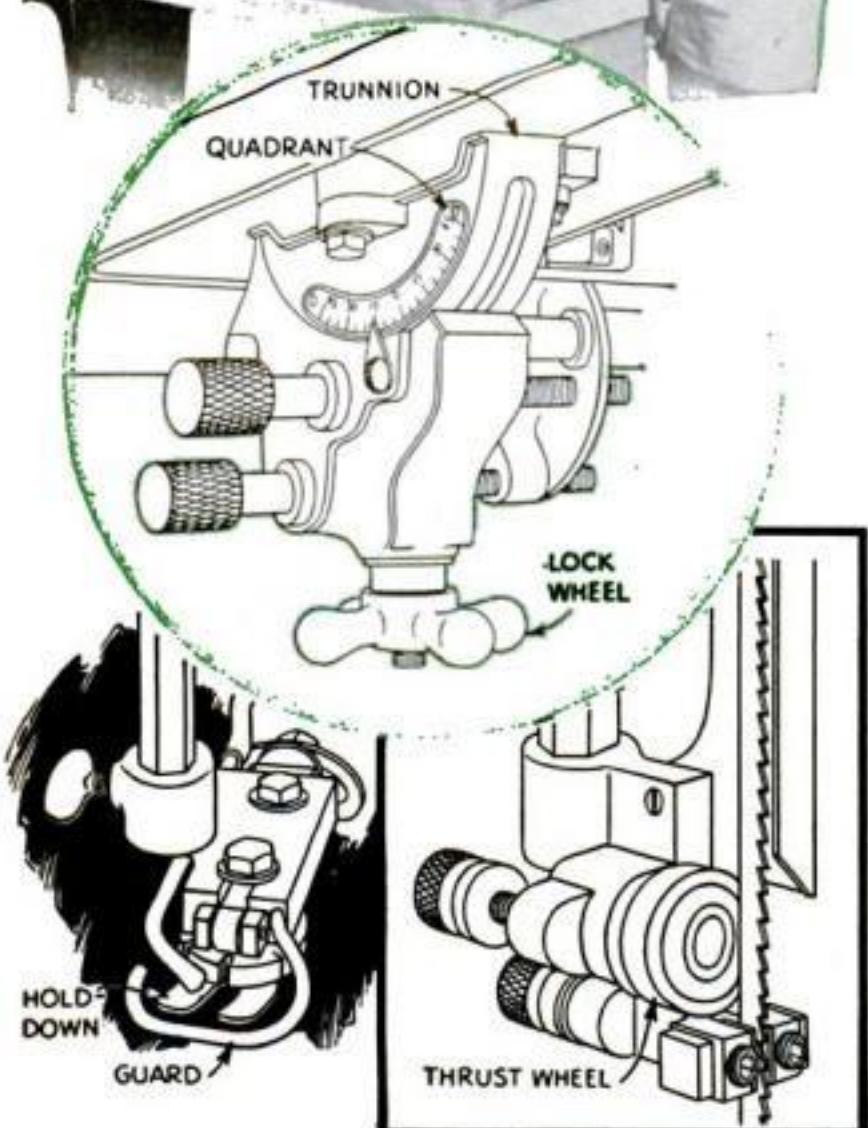


In another type of saw the arbor tilts instead of the table. The drive pulley slides on a splined motor shaft, centering itself with the arbor pulley. The long extension bars enable the ripping gauge to be set out 24" from the blade

Jaacks investigates the spring tension of a 24" scroll saw. It can be adjusted while running. A roller guides and backs up the blade, and a pump in the cylinder blows sawdust away



A 10" band saw with lower guard removed. Note the square blade guides adjustable to the thickness of the blade, the backing disk behind the blade, and the spur-and-pinion to tilt the table



In circle, the table mounting of a well-designed band saw. A quadrant shows the amount of tilt. At left, an accurate type of scroll-saw guide. Right, ball-bearing thrust wheel of a band saw

method of widening is to screw stiff bars to the front and rear edges as bases for the ripping fence. The width thus obtained enables the saw to rip down the center of a 48" wide panel.

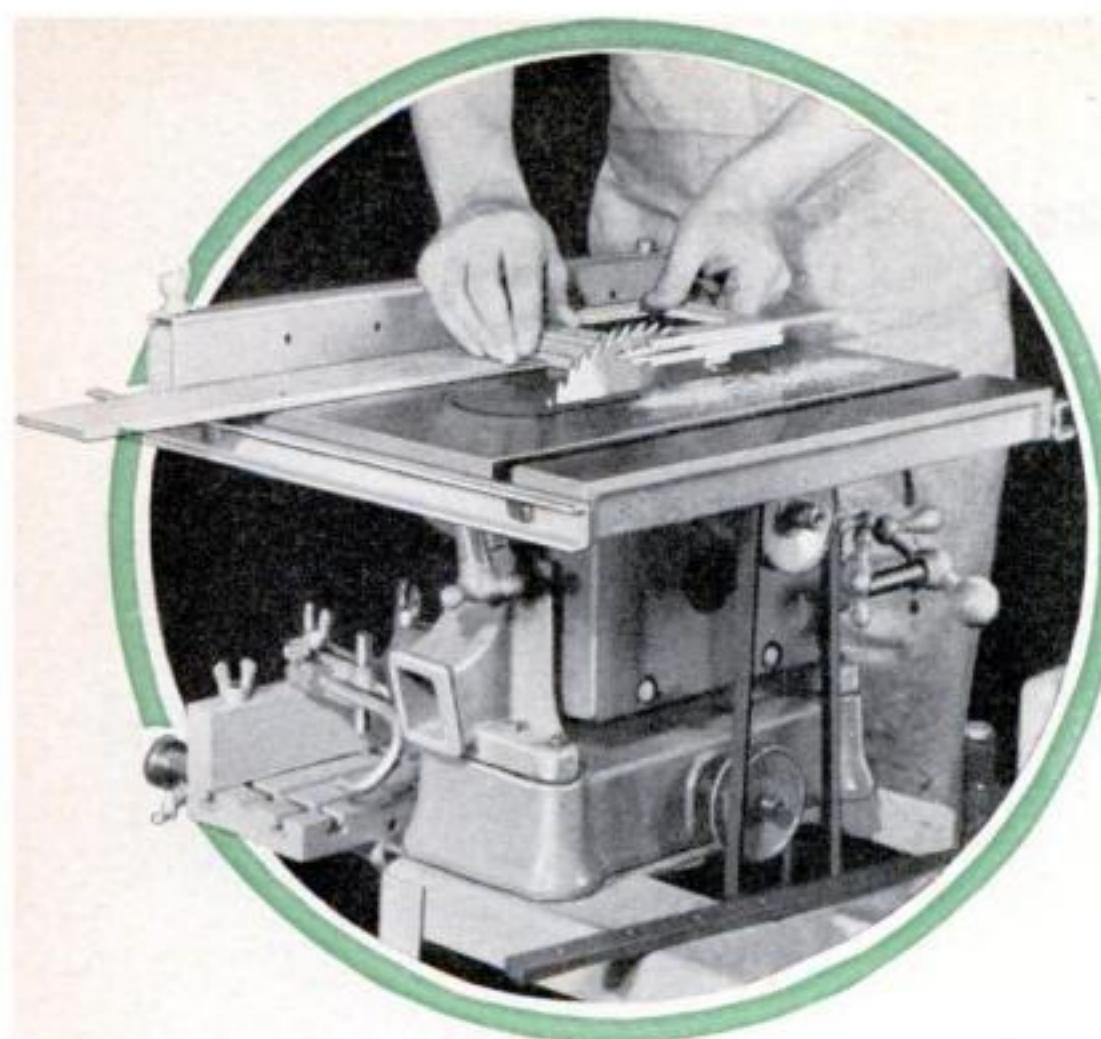
Are there any constructional points that especially influence accuracy?

Rigid bracing is one thing. If there is much vibration, the saw cuts roughly and handles poorly. Heavy body castings tend to reduce vibration, but other factors enter in. Parts must be strongly bolted together, and where one slides on another, accurate adjustable guides are necessary.

Good ball bearings decrease friction and eliminate play. The increasing practice of sealing grease in the bearings at the factory relieves the owner from oiling or otherwise tending them for the entire life of the machine.

How can one choose between the relative merits of a tilting saw table and tilting saw arbor?

In the writer's opinion, the tilting arbor (shaft) has advantages from the standpoint of convenience. Of course, short work can be handled easily on a tilting table, but with that type of saw crosscutting on a bevel is often impossible on long boards because the ends would strike the ceiling or floor. The table of a tilt-table saw should be mounted



Cutting a paneled frame to size on the saw. First fit a block into the panel recess. Lay a thin strip against the ripping fence and adjust to bear against the block. Then trim one edge and turn the panel to trim the other. In this way both stiles are cut to exactly the same width

on two widely spaced rockers or "trunnions" capable of being rigidly clamped, as in the drawing of the band-saw table.

What drives are used on home workshop circular saws?

The V-belt is most commonly used. A cord-and-rubber belt of wedge-shaped sec-

tion runs lightly in grooved pulleys. As the load increases, the belt wedges deeper into the grooves, preventing slipping. Little power is wasted.

Stock motors or gasoline engines are easily used with this drive. A correct size of pulleys is chosen to adjust the speed of the motor to the saw. The drive works well on a tilting arbor because a twist in the belt matters little.

Some saws are direct-driven, the motor shaft acting as an arbor. Power is efficiently delivered to the teeth, but the saw speed is fixed by the motor speed. In other saws, a gear on the arbor meshes with one on the motor shaft, forming a positive, efficient drive operating in a bath of oil. A proper ratio of teeth is needed to give the saw the correct speed.

Any saw worth buying should take standard accessories and have a rip gauge capable of being rigidly clamped at front and rear, also a crosscut gauge with quick-setting stops.

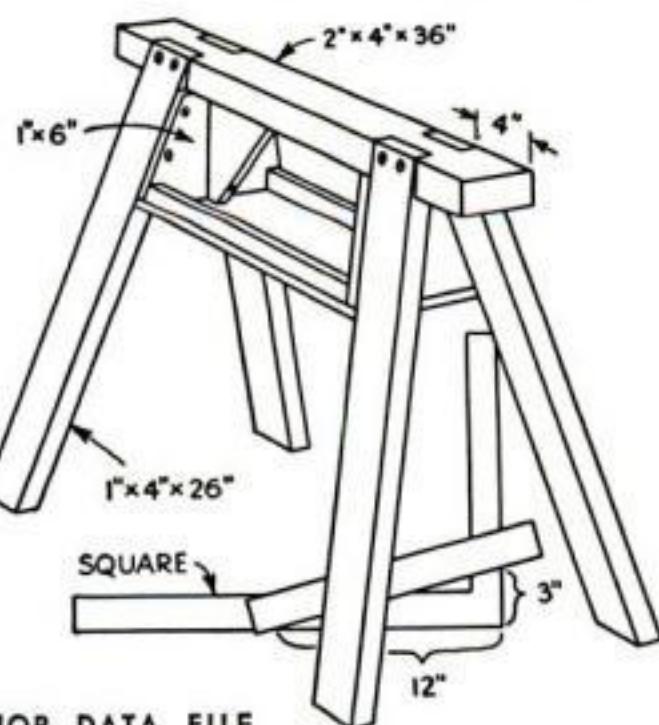
Good jointer construction involves what items?

As with the saw, rigidity and wear adjustment are essential. The fence should tilt both ways, permitting beveling with the grain of the wood. If equipped with adjustable stops, it will return to the square or mitering positions after being shifted. Other things being equal, the larger the cutter head, the smoother the cut, as a flatter shaving is scooped out. For greatest durability,

SAWHORSES

1. Use 2" by 4" stock for top of horse and 1" by 4" stock for legs. Cut legs 26" long, beveling faces and edges on a slant in the proportions of 3" in 12." Mark sides of gains (notches) for legs by running a pencil along the edges of the legs, and number them to identify them. Gauge depth of gains on top and bottom of the 2" by 4" and saw the sides. Chisel out the waste. Drill and countersink the legs for 1½" flathead screws, and screw to toppiece. Cut 1" by 6" braces to screw inside legs, against top. Fit angle braces against these pieces and the top, and screw in. A thin shelf with low sides may be nailed beneath braces to hold tools.

[WOODWORKING]



be sure to specify blades of high-speed steel.

In the ideal scroll saw what improvements can be found?

The table and blade holders, if mounted to allow cutting from the front or side, permit the ripping of long boards, and this is obviously desirable. The chucks should take files and sanding accessories. If the saw is equipped with a separate hold-down, this should be designed to ride easily over small inequalities, tilt with the table, and enable the upper guide to be placed close above the work. A counterbalanced crankshaft running in oil reduces wear and vibration, and a four-speed drive fits the machine to work in wood, metal, and plastics.

Name some of the desirable features to look for in a wood-turning lathe.

Bed ways should be smoothly finished. For metal spinning, a massive headstock is needed. Some provision for large faceplate turning, such as a notched bed or a threaded extension of the spindle beyond the lathe end, is desirable. A dividing mechanism is often useful, and a hollow spindle with Morse taper simplifies the changing of chucks, sanding drums, and the like.

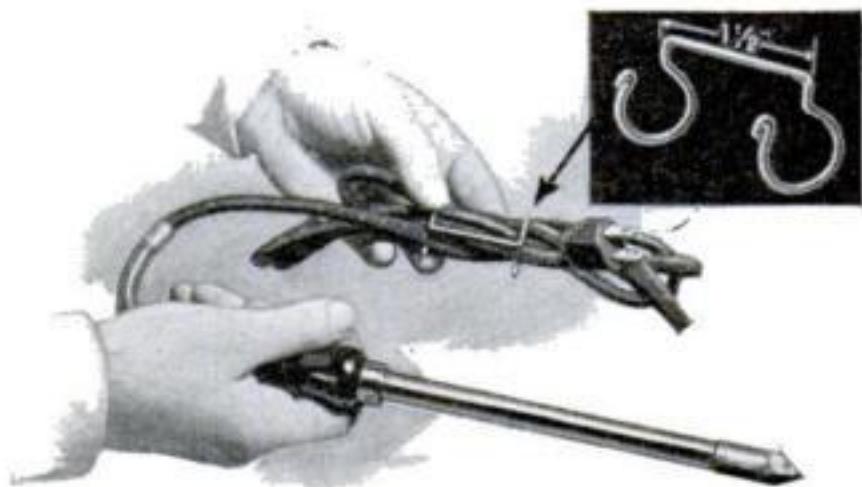
What are the characteristics of a good drill press?

The drill should have "floating" spindles which can be changed in a moment's time. The chuck capacity is usually up to $\frac{1}{2}$ ". In the best construction the pulley is independently mounted on ball bearings, taking the belt strain. Power is transmitted to the

spindle through a flexible coupling device, such as splines, to compensate for slight variations in the relative centering of pulley and spindle. Adjustable boring stops and four speeds are considered standard.

In a band saw, what features are of importance?

Rigidity and adequate size are essential. Other details to look for are a screw-tensioning device, easily controlled tilting for the upper wheel to make the blade "track," and accurately adjustable guides with ball-bearing thrust wheels for the blade. Substantial guards covering both wheels and all exposed portions of the blade are required.



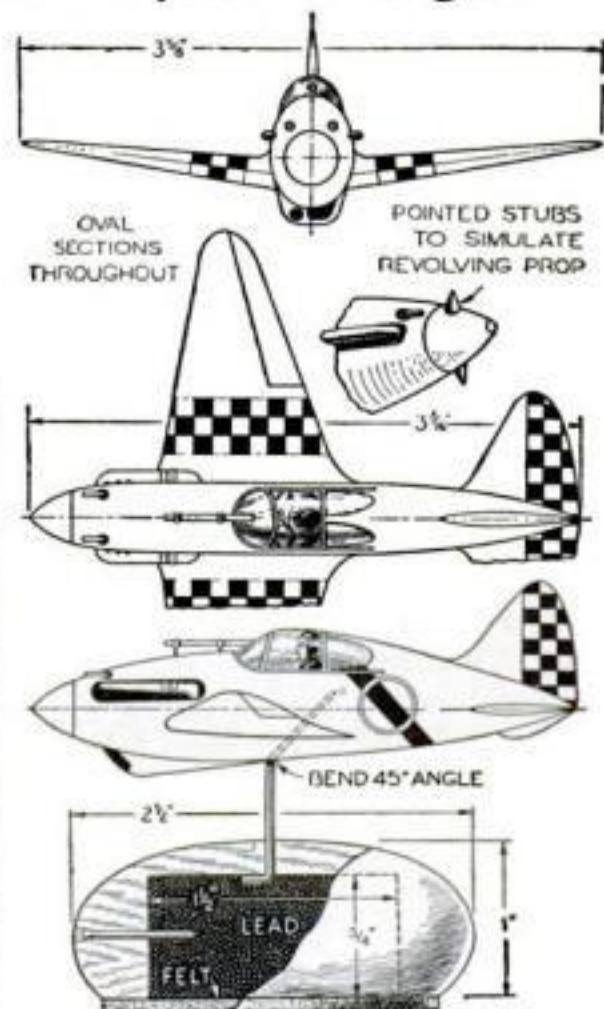
Folded Appliance Cord Held by Wire Clip

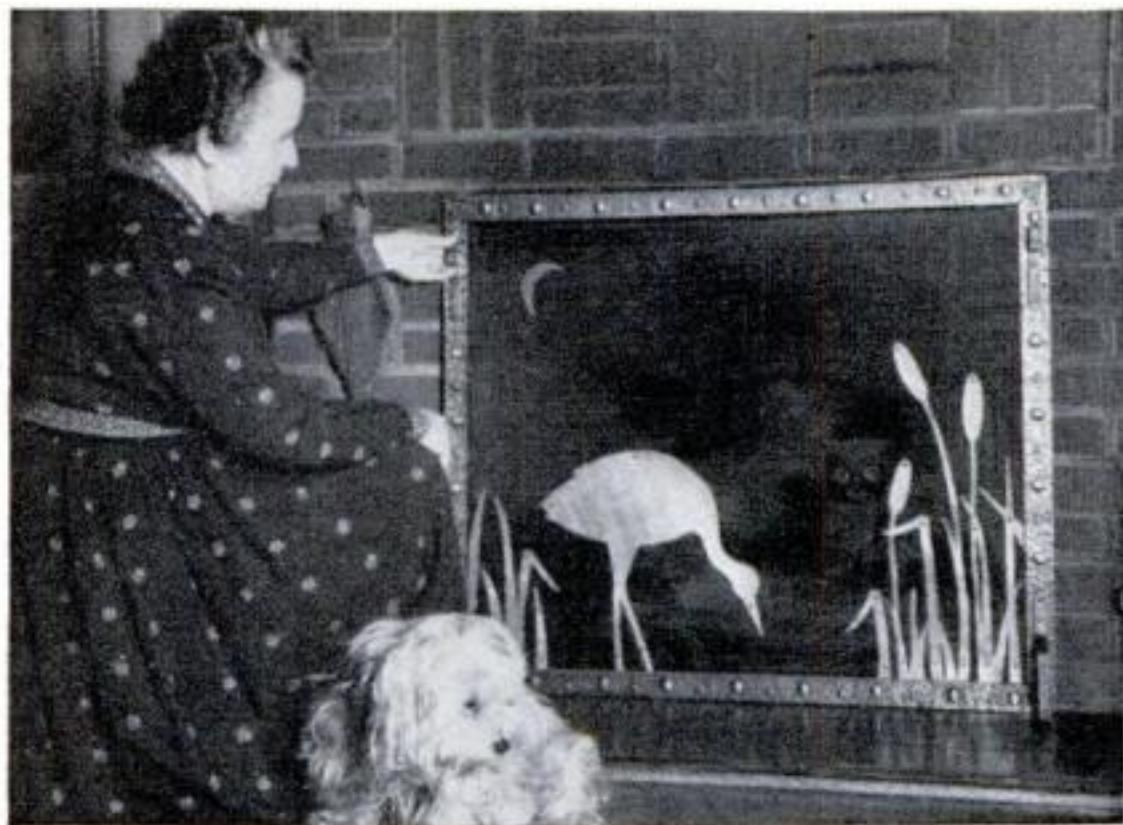
TO PREVENT the cord of an electric soldering iron or other appliance from becoming tangled when not in use, a clip can be made as shown from clothes-hanger wire. This snaps over the folded cord.

Miniature Fighting Plane Decorates Paper Weight

ANY aviation fan will find a paper weight like the one illustrated is a most appropriate desk piece. The weight is made from a close-grained wood and hollowed out to take a disk of lead. Make the model itself of white pine or basswood. Apply generous applications of cement at the roots of the wings to form fillets and for strength. As an undercoat, brush on model-airplane paper cement (banana oil) and sand smooth. Use pigmented model dope for coloring.

If you are the imaginative type, you probably will enjoy decorating the model like some mysterious fighting plane. It could, for example, be colored gold with green-checkered designs, or all Chinese red or all black with suitable insignia. The model can be turned in any flying position desired.—R. L. CLIFFORD.





The feet are fastened in front so that they hold the screen firmly against the fireplace. The silhouettes are of brass

Each piece of wrought iron is peened and then sanded lightly



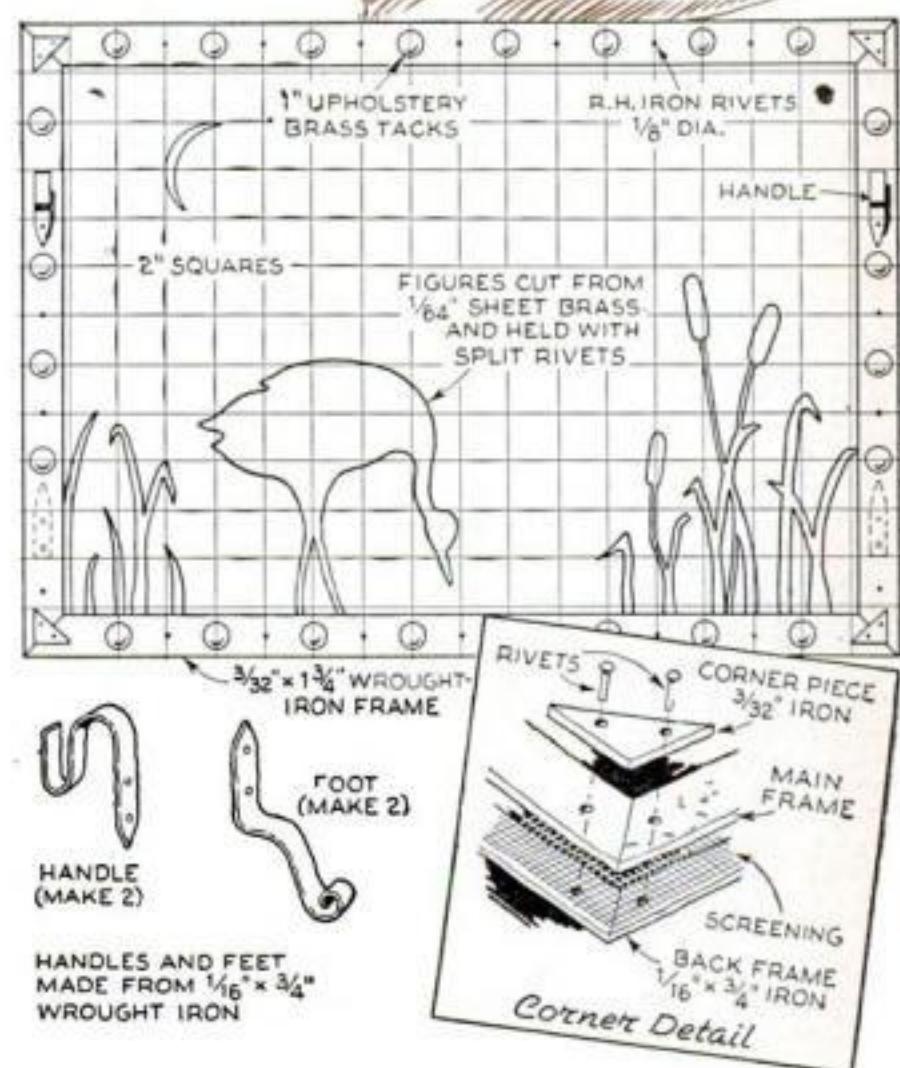
Fireplace Screen OF WROUGHT IRON AND BRASS

IN ADAPTING this screen to your fireplace, change the dimensions so the height is 1" greater and the width 2" greater than the opening. If you have a forge or any type of furnace, you can save considerable energy in shaping and peening the iron, but heating is not essential.

Cut the iron to length and use a small ball-peen hammer to peen the parts for the front or main frame, the handles, and the feet. Lightly sand the surface of the metal, leaving the hammer marks black. Then rivet the feet and handles to the sidepieces. Next, assemble the frame by riveting on the small triangular corner pieces, and be sure the frame is square when you drill the necessary holes.

Place the frame face down and lay on it a piece of fireplace screen. On top of this set each of the iron back bars, one at a time, and clamp it in place while you drill for the rivets and the ornamental brass tacks, spaced about as shown in the photograph.

The silhouettes can be cut on the jig saw or with tin shears and cold chisels from 1/64" thick brass. They are held with small split rivets that extend through the screen. When the screen is completely assembled, burnish the brass and wrought iron lightly and coat with thin lacquer.—E. J. HOBERT.



Spray Gun Cleans Typewriter

PORTABLE typewriters can easily be cleaned by removing the ribbon, inverting the machine, and thoroughly spraying all parts of the undercarriage with an ordinary insect spray gun filled with white gasoline. Wipe off with a soft cloth and let dry, then oil carefully.—K. F. K.

Thumb-Tack Lifter Made from Picture Hanger

AN EXCELLENT thumb-tack lifter can be made from an ordinary picture hook by filing a notch into the small end as illustrated below. That end is then filed down to a sharp edge to permit it to be slid under the tacks. The large hooked end forms the handle, and the tack is raised merely by rocking the hanger upward to exert a leverage underneath the tack's head.—H. RADZINSKY.



Typewriter Eraser Removes Wire Edge from Tools

AN ORDINARY circular typewriter eraser, if mounted on a 6-32 machine-screw mandrel and rotated in a chuck, is an efficient tool for taking off the burrs and wire edges from small tools after grinding.



Fast-Growing Beans Mark Rows of Slower Plants

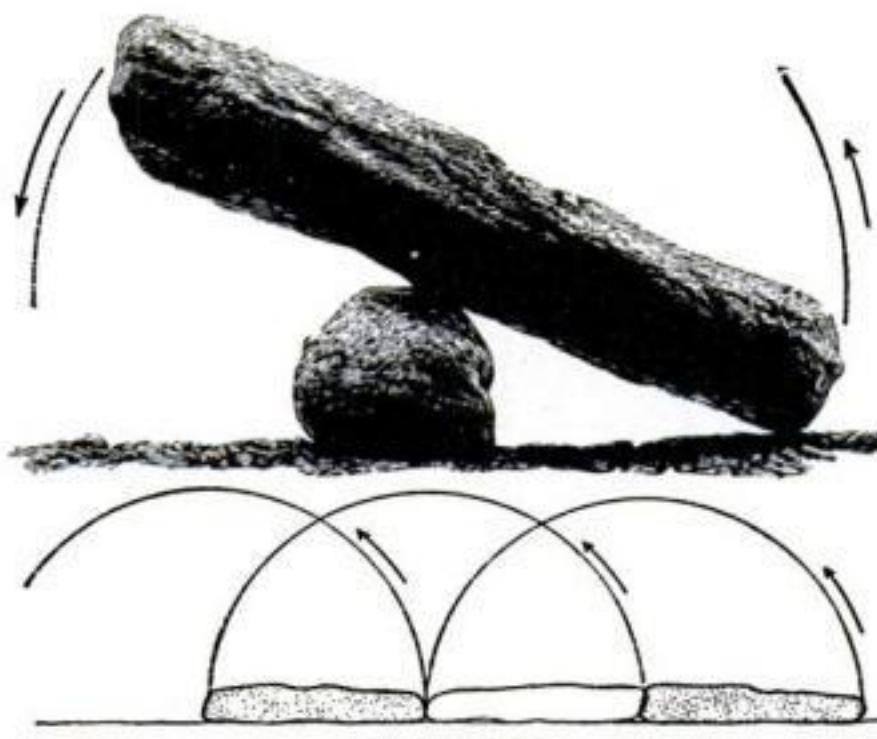


HOME gardeners are often annoyed by the slow growth of carrots and similar vegetables because it is hard to tell exactly where the rows have been planted so as to avoid injuring the plants in early cultivation. To mark the rows, simply plant ordinary navy beans at intervals. The beans, growing so rapidly, soon appear above the surface of the soil and mark the rows plainly.—G. HENDRICKSON.



Old Water Tank Serves as Ratproof Feed Bin

A DISCARDED vertical water tank can be converted into a ratproof feed storage place for a small farm. The tank is merely laid on a suitable platform and the open end inclosed with 1" boards in which a door is cut. The side of the tank with the fittings is turned upward so they will act as ventilators.—EMIL PEARSON.

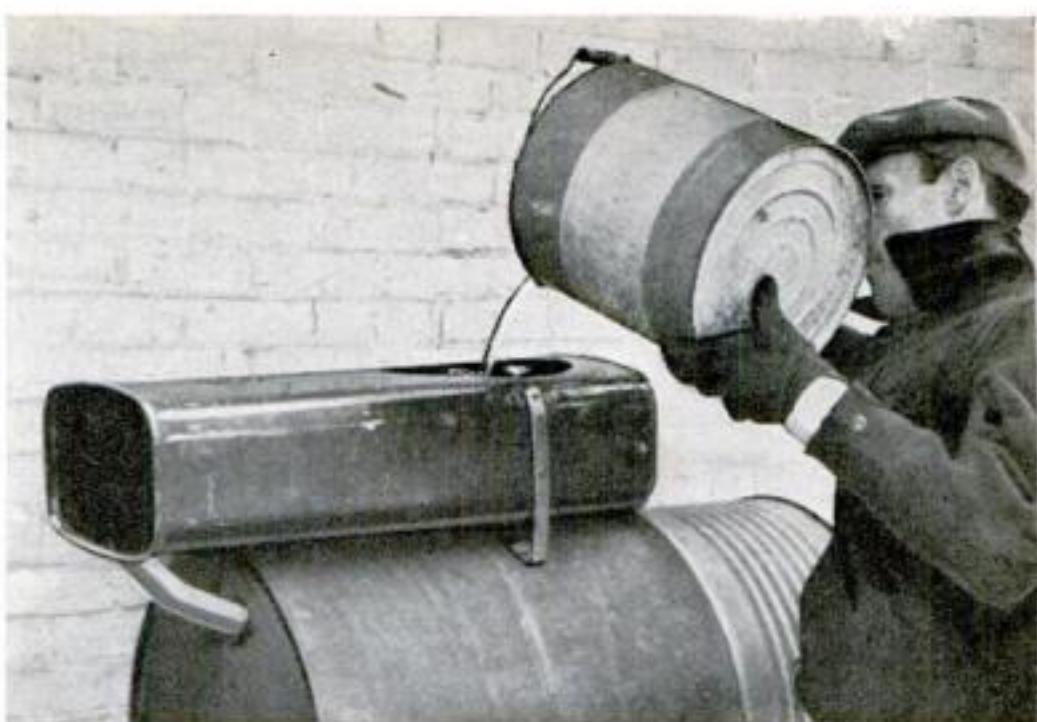


How to Move Flat Rocks with Little Effort

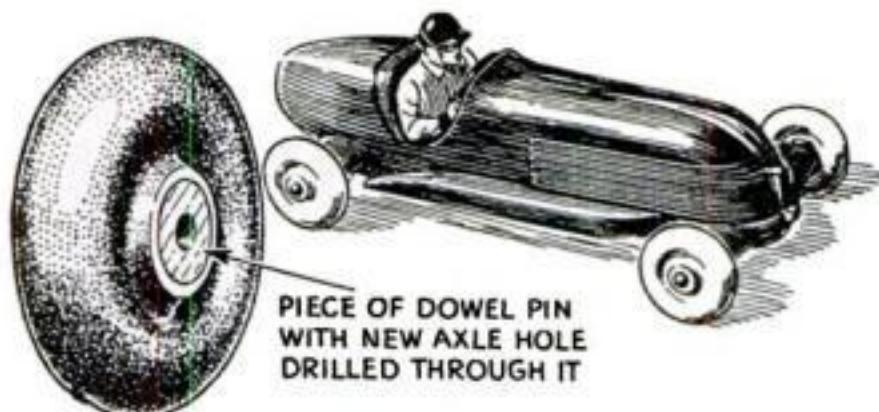
IN BUILDING a stone wall or outdoor fireplace, or even in preparing a garden, it is often necessary to roll a heavy, flat rock for some distance. This can be made very much easier by letting the rock come down each time on a smaller round rock. Place this approximately under the balancing point of the rock to be moved.—W. H. F.

Funnel for Filling Horizontal Barrels

BARRELS having the filler hole in one end need not be upended for filling if a large funnel is made as shown. A flat gasoline tank with a curved filler spout is obtained from a junk yard. A large hole is cut in the top, and the spout is removed and soldered on the underside of the tank so that it will fit into the filler hole on the barrel. A length of strap iron bent as illustrated makes a good support for the tank when it is placed on the barrel. The strap iron under the tank is bent to the curve of the barrel.



The spout from an old flat gasoline tank is removed and soldered underneath. A large hole is cut out of the top



Dowel Bushings Lengthen Life of Toy Wheels

SOLID rubber wheels on small toys often become wobbly, but this can be prevented by removing the wheels when they first show signs of wear, and fitting wooden dowels snugly in enlarged holes. Drill a hole in the center of each dowel for the axle. Add a drop of oil and clinch the end of the axle.

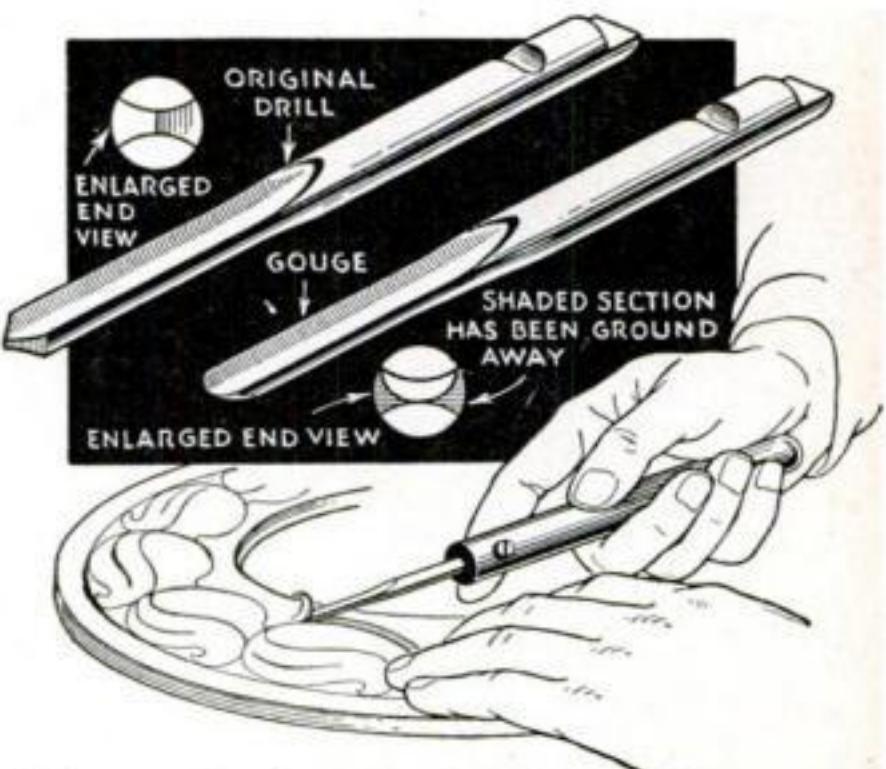


Flour Aids in Sowing Grass Seed

THE broadcasting of grass seed is facilitated if some material is added to increase the volume. Gardeners often use fine sand, but flour is better because its visibility aids in obtaining a more even distribution. A jar with a perforated lid is a suitable container for scattering the seed.—W. C. CRYAN.

Tiny Gouges for Carving Made from Wood Drills

VERY small carving gouges can be made as shown from straight-fluted wood drills such as are supplied for use with spiral screw drivers. With these drills the flutes are already provided, so grinding the gouges is a simple matter. For the handle, drill a hole the same size as the shank of bit into the end of brass rod, $\frac{3}{8}$ " in diameter and 5" long, and insert a set screw where it will lock the bit. Round the ends of the handle.—LEROY RAISER.



End views show how fluted wood drill is transformed into gouge

Hardener for Plaster of Paris

Carpenter's glue diluted with twice its usual amount of water forms an efficient hardener for use with plaster of Paris.

Large Panels Supported by Wire for Band-Sawing



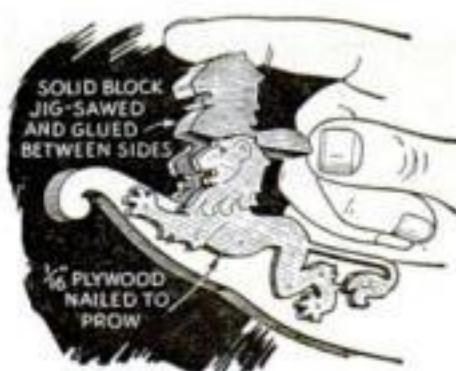
Very large plywood panels can be sawed easily if suspended by a wire from the ceiling of the shop

FACED with the task of sawing out 4' circles from five-ply panel boards, a wood-worker relaxed his weary right arm by hanging the work from the ceiling with a wire. The height was adjusted by a light turnbuckle linked into a screw hook at the center of the panel. By supporting the work slightly above the table level, the wire removed most of the friction so that the work literally floated up to the saw.

Still larger work can be handled in the same way.—HOLT CONDON.

Ornate Figurehead Attached Firmly to a Ship Model

FIGUREHEADS of galleons and similar ship models are usually notched to fit over the stem, but a stronger method is to cut two pieces of 1/16" thick plywood of the shape of the figurehead and fasten them to the stem. Then insert a solid piece between them, mark the outline, jig-saw it to shape, and glue it in place. Such figureheads never crack and do not come off.
ANTONIO GELINEAU.



Handy Bottle Stoppers

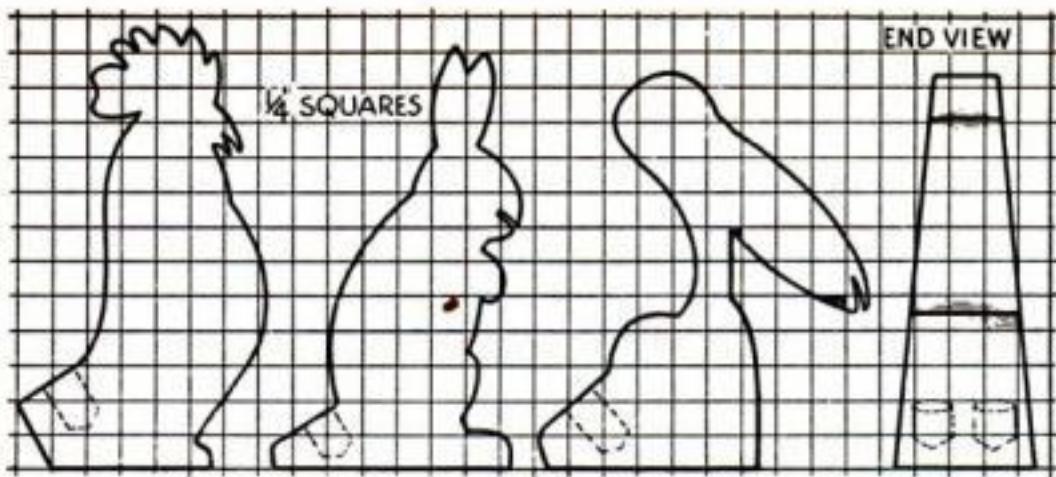
GOOD substitutes for corks are ordinary rubber sink stoppers, which can be obtained in a variety of sizes to fit most bottles. They are not only resistant to most photographic solutions, but are also fitted with rings that offer excellent grips when removing them.

HOW TO CLEAN WALL PAPER



1. Dust walls with a vacuum brush, if available.
2. Spread drop cloth on floor to catch crumbs; then take a fresh loaf of rye bread, cut it squarely in half, and use the cut face to clean the wall areas from the top down. Rub in straight, partly overlapping strokes until the end of the loaf is slightly soiled; then cut off a thin slice to expose a new area. Repeat for the entire section as required.
3. For areas that are badly soiled, use a commercial cleaning paste or dough. This is sold by most wallpaper stores under various trade names.

[SHIPSHAPE HOME]



Place-Card Holders OF TRANSPARENT PLASTIC

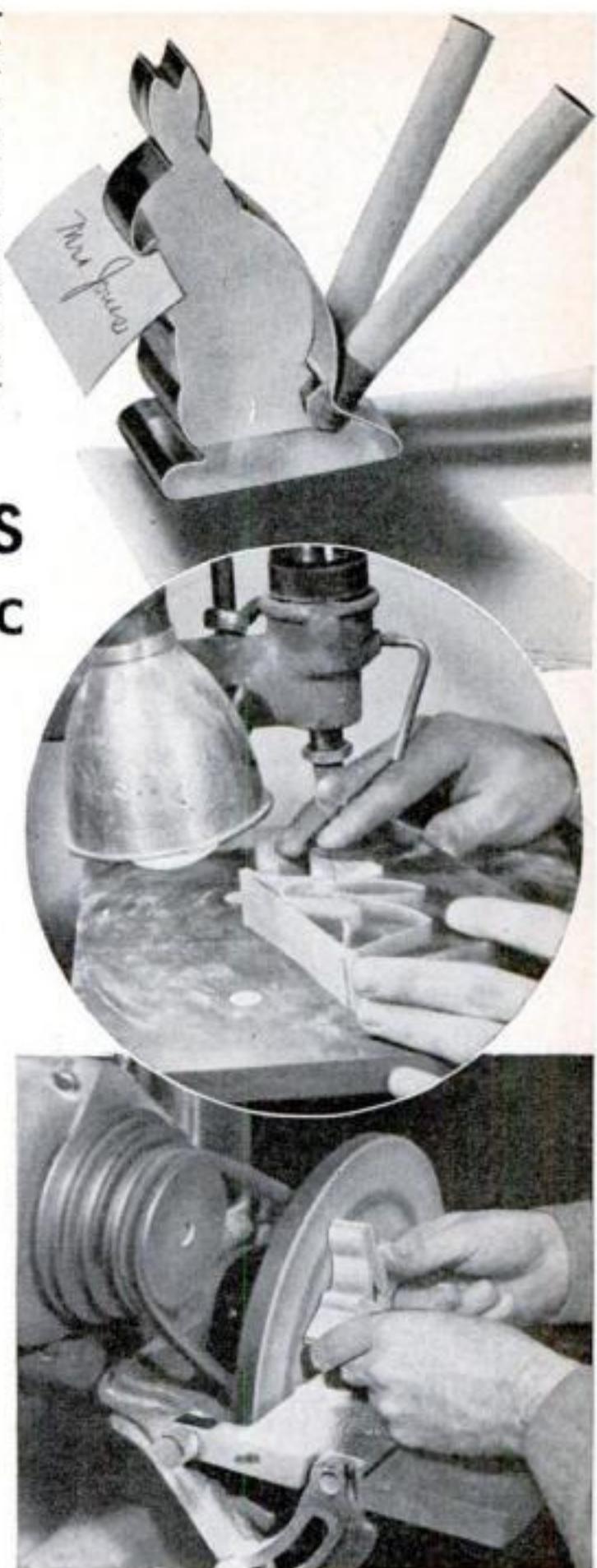
ATTRACTIVE place-card holders are easily made as shown from 1" thick cast-resin plastic or other suitable material. The designs were created in the New York laboratory of the Metropolitan Junior Achievement and have proved so popular that many have been sold.

The plastic used is crystal-clear, but any gay color could be substituted. If only one or two holders of a pattern are to be made, the design may be drawn on paper and the paper glued to the plastic block. When a number are required, a template should be cut from thin sheet metal, and the outline traced directly on the plastic with a sharp scribe.

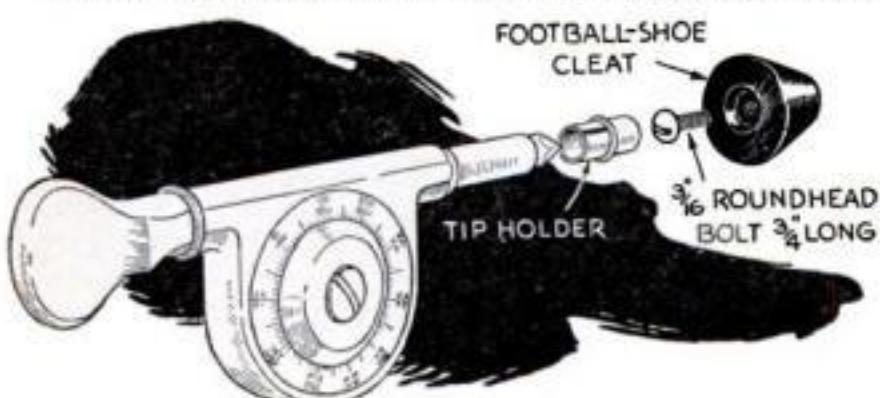
The holders are cut on a jig saw with a fine blade such as a jeweler's blade No. 3. Guide the plastic rather lightly against the saw to avoid scorching. The sides of each piece are then tapered from 1" at the bottom to $\frac{1}{2}$ " at the top with a motor-driven disk sander faced with fine sandpaper. This done, a slightly curved slit is sawn for the mouth; it is in this that the place card is held. Two $\frac{3}{8}$ " holes are drilled in the after part of the base as illustrated to hold two cigarettes. If desired, eyes may be indicated by light touches with a fine drill.

The ground-glass appearance of the plastic where it has been cut, drilled, or sanded may be restored to the original brilliant luster by polishing. Initial polishing is done on a high-speed muslin buffering wheel charged with a creamy mixture of No. 00 pumice and water. The work should be held lightly against the underside of the buff, slightly below center. Pumice polishing should continue until all tiny scratches and tool marks are removed. Clean off the excess pumice by washing the work in cold water.

The final high luster is obtained by first waxing



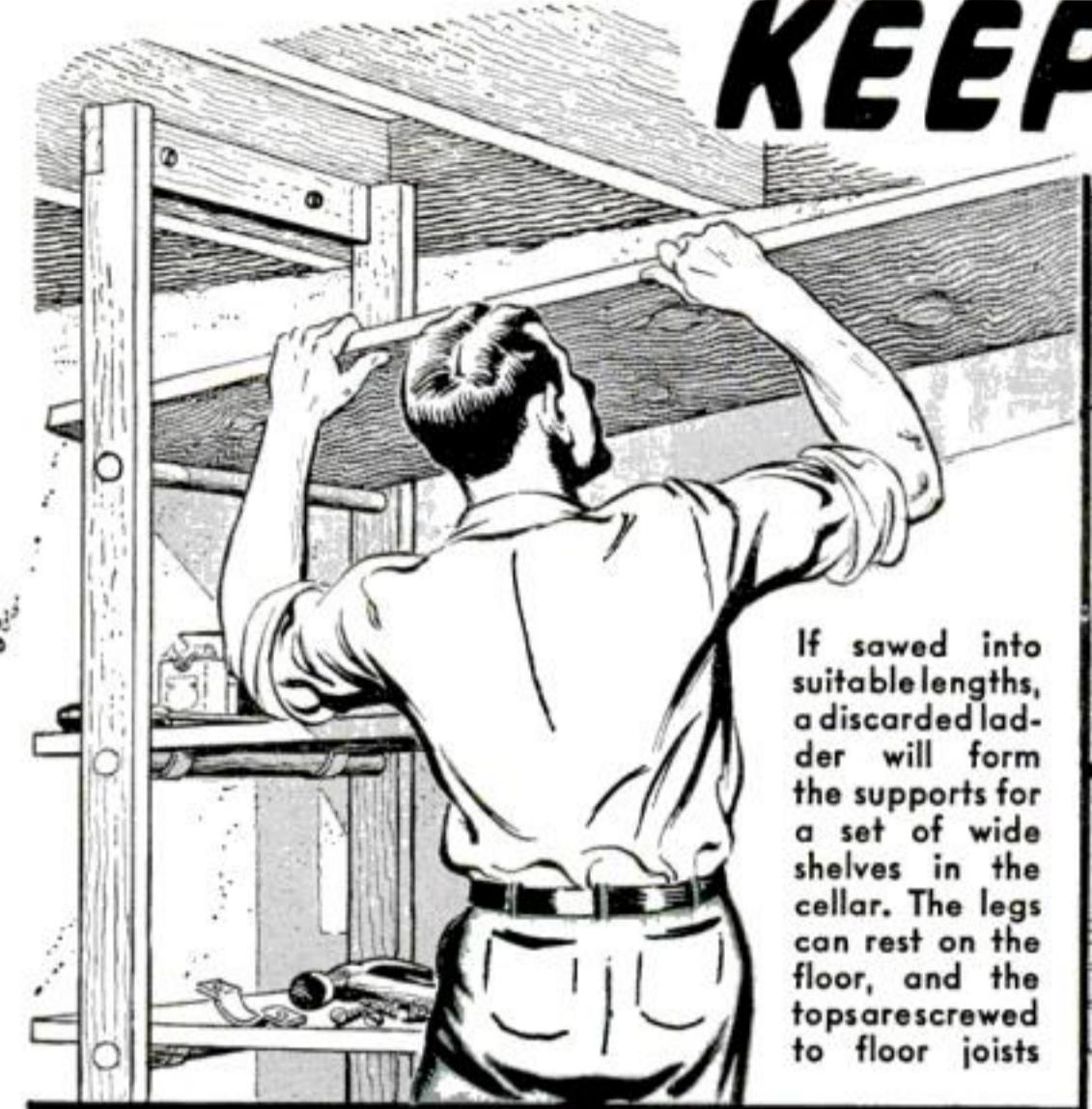
with a compound prepared for the purpose by the manufacturer of the plastic, or with a clear powdered floor wax, and then by buffering on a clean, dry wheel. Crystal-clear plastic was used for the design illustrated above in order to harmonize with a white table ensemble.—KENNETH M. SWEZEY.



Football Shoe Cleat Serves as Speed Indicator

USED as a speed-indicator tip, a detachable football shoe cleat will outwear dozens of ordinary soft rubber tips. Turn a bolt into the cleat. The bolthead will fit tightly into the regular tip holder.—JOHN LAPIN.

KEEPING THE



If sawed into suitable lengths, a discarded ladder will form the supports for a set of wide shelves in the cellar. The legs can rest on the floor, and the tops are screwed to floor joists



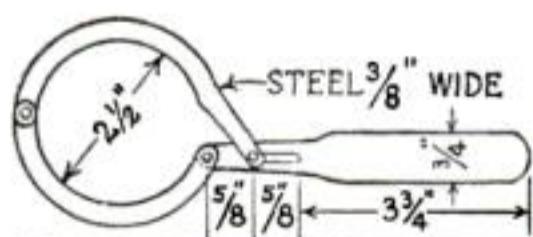
A heavy tumbler or jelly glass, if placed over a watch in a sickroom, will quiet the ticking, which is often annoying to a person who is very ill



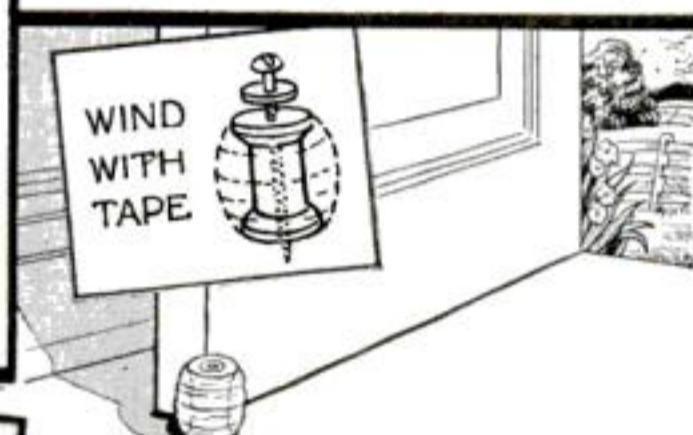
Made of $3/32$ " thick steel hack-sawed and filed to shape as shown below, this tool removes or tightens Mason-jar lids easier than most commercial devices. Assemble with rivets so joints work freely



When large quantities of laundry have to be marked for identification, the work can be speeded up by bending a length of wire as shown and pressing the ends into a large cork. The cloth is inserted and the wire ring clamped down



The wing-type drain plugs used on certain types of washing machines can be turned faster and easier if fitted with a crank of $1/16$ " by $1/2$ " steel and a wooden handle



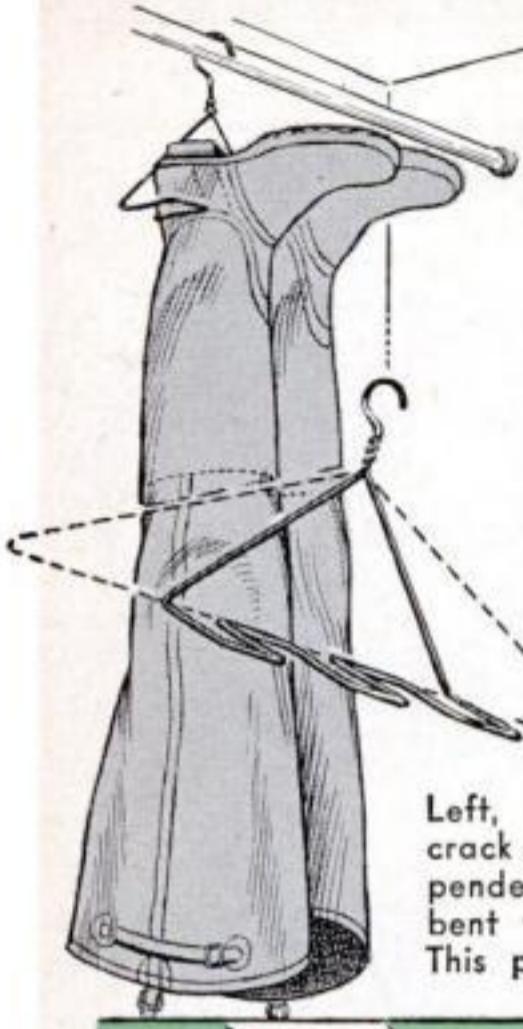
A spool wrapped with rubber splicing tape or other resilient material makes a good automatic doorstop if placed where the door will just squeeze by it



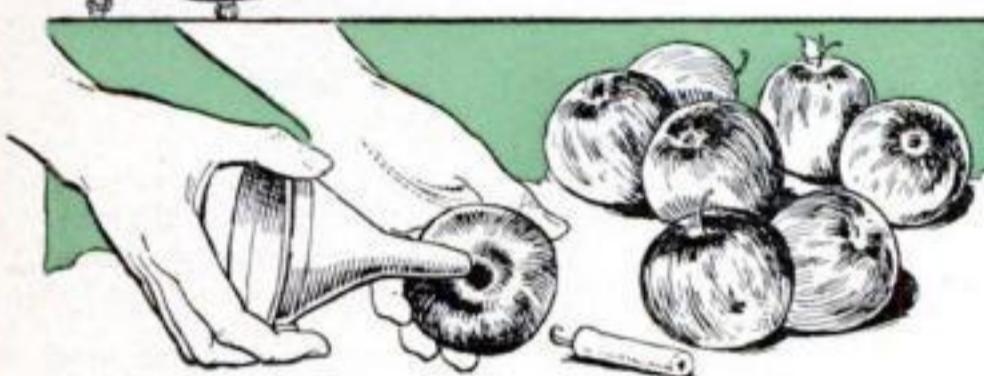
Window curtains can be stretched by placing $\frac{3}{8}$ " iron rods in the top and bottom hems. Enamel the rods well to prevent any rust stains



HOME SHIPSHAPE



Left, rubber hip boots will not crack and rot so quickly if suspended by their heels from a rack bent from a wire clothes hanger. This provides adequate ventilation



Various types of coring devices are sold for preparing apples for baking or stewing, but a small, sharp-edged metal funnel makes a convenient tool for this purpose

When a rubber hot-water bottle is filled, the air becomes trapped and "blurps" out, causing delay and sometimes scalded fingers. A small tongue-shaped piece cut from sheet aluminum or fiber will prevent this



If there is a discarded floor lamp stored away in the attic, it can be put to good use by converting it into an adjustable mirror to aid in hair dressing. Remove the top and add an adjustable arm of $\frac{5}{8}$ " thick plywood pivoted on a bolt between two $\frac{1}{2}$ " plywood cheeks. Mount a mirror on the arm



To hold a cellar window open, a self-locking latch can be made by screwing a wooden knob to the sash and setting a wire broom clamp where it will engage it, as illustrated above



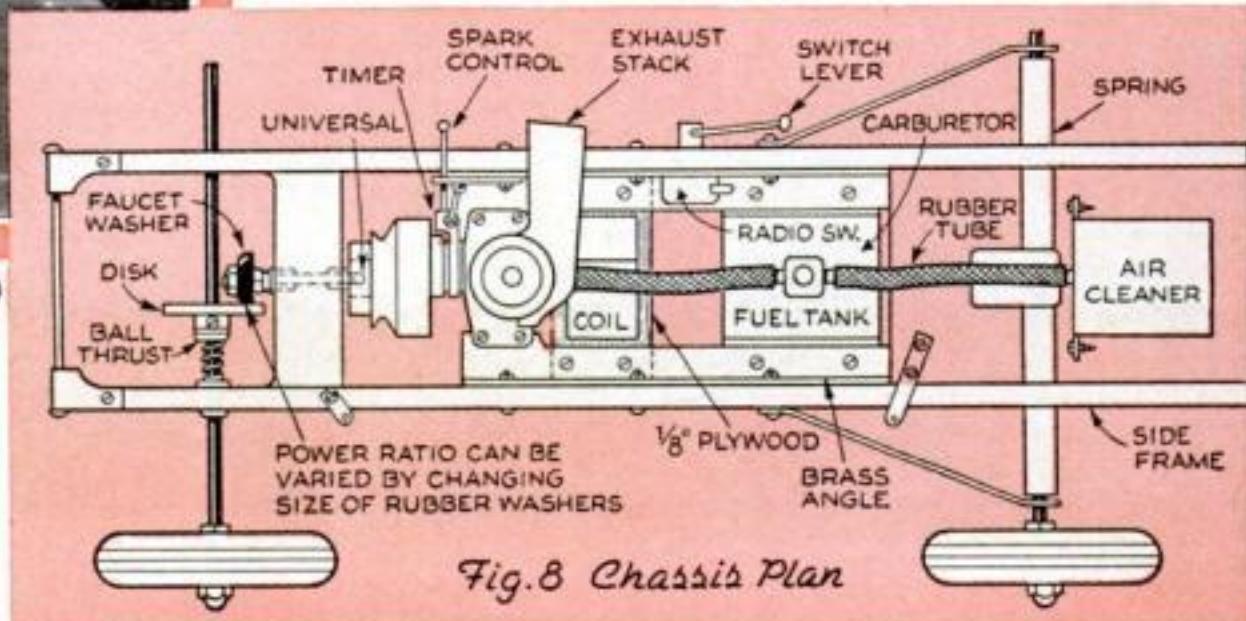
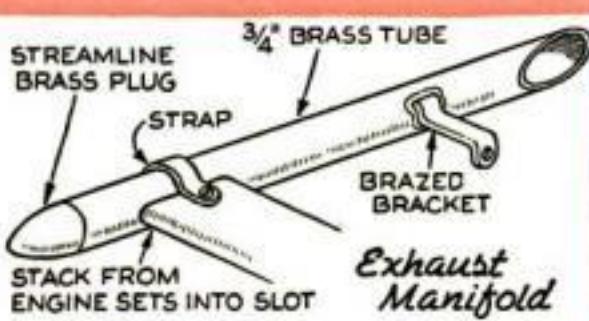
"TINY TORNADO" TRAVELS
ABOUT 60 MILES AN HOUR



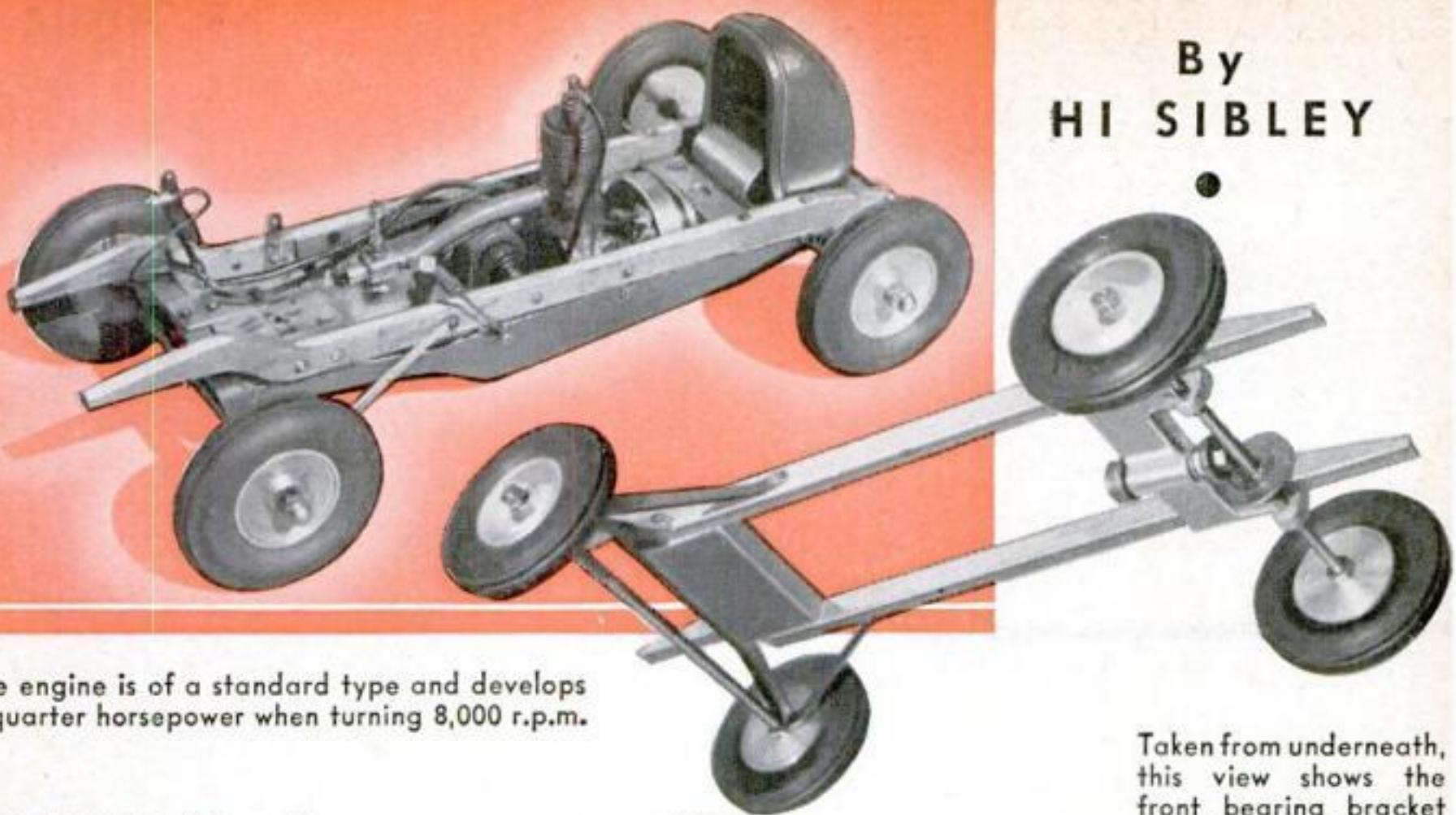
Ready for the track, the model is 20 $\frac{3}{4}$ " long, 9 $\frac{1}{4}$ " wide over all, and 7 $\frac{1}{4}$ " high

HERE'S HOW TO
COMPLETE OUR

Superspeed



By
HI SIBLEY



The engine is of a standard type and develops a quarter horsepower when turning 8,000 r.p.m.

Taken from underneath, this view shows the front bearing bracket and drive shaft. Only the rear axle needs to have spring suspension

midget Racer

How the various parts are assembled can be seen from this "taken apart" drawing. Details of the chassis frame and body members appeared in the previous installment

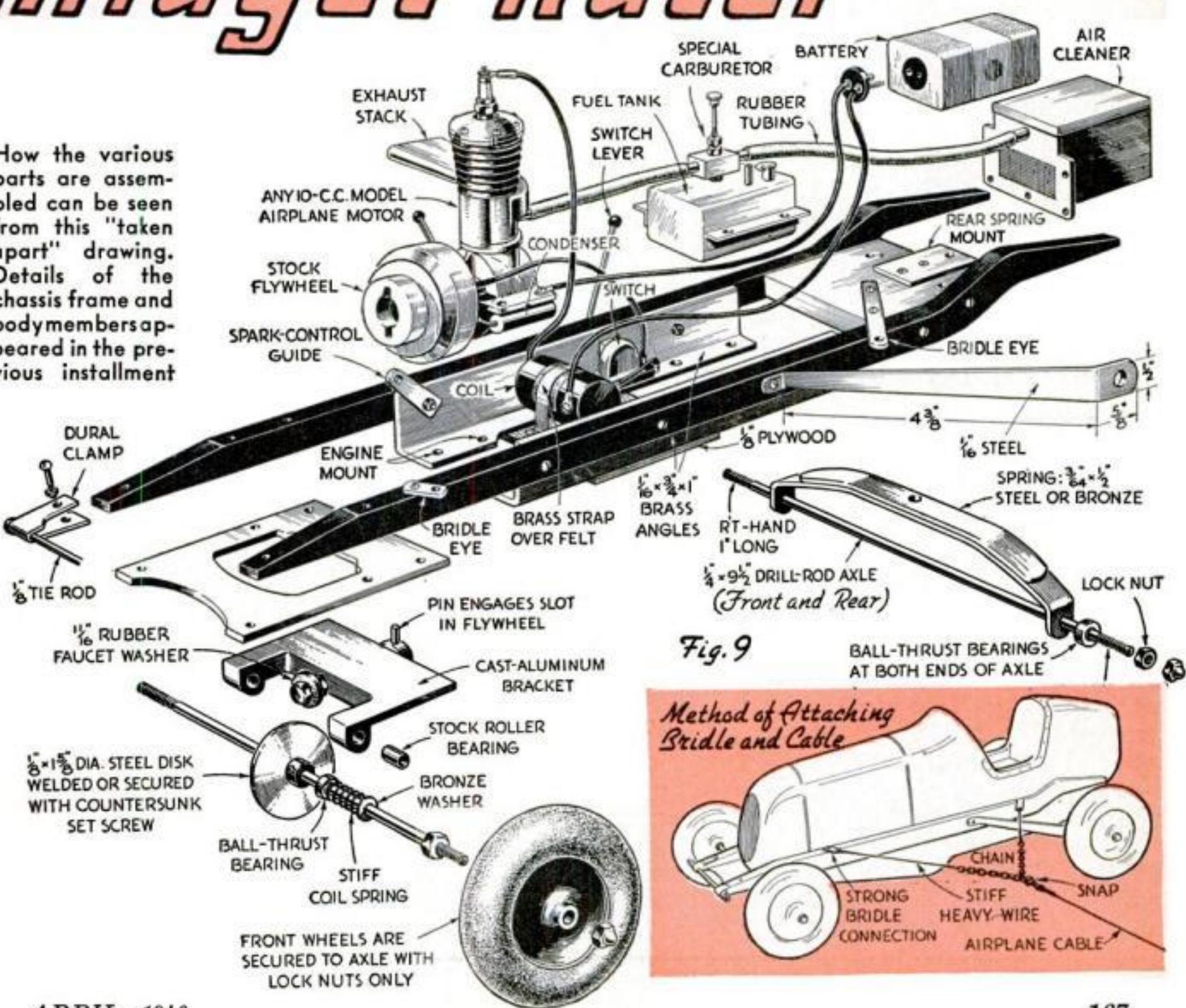
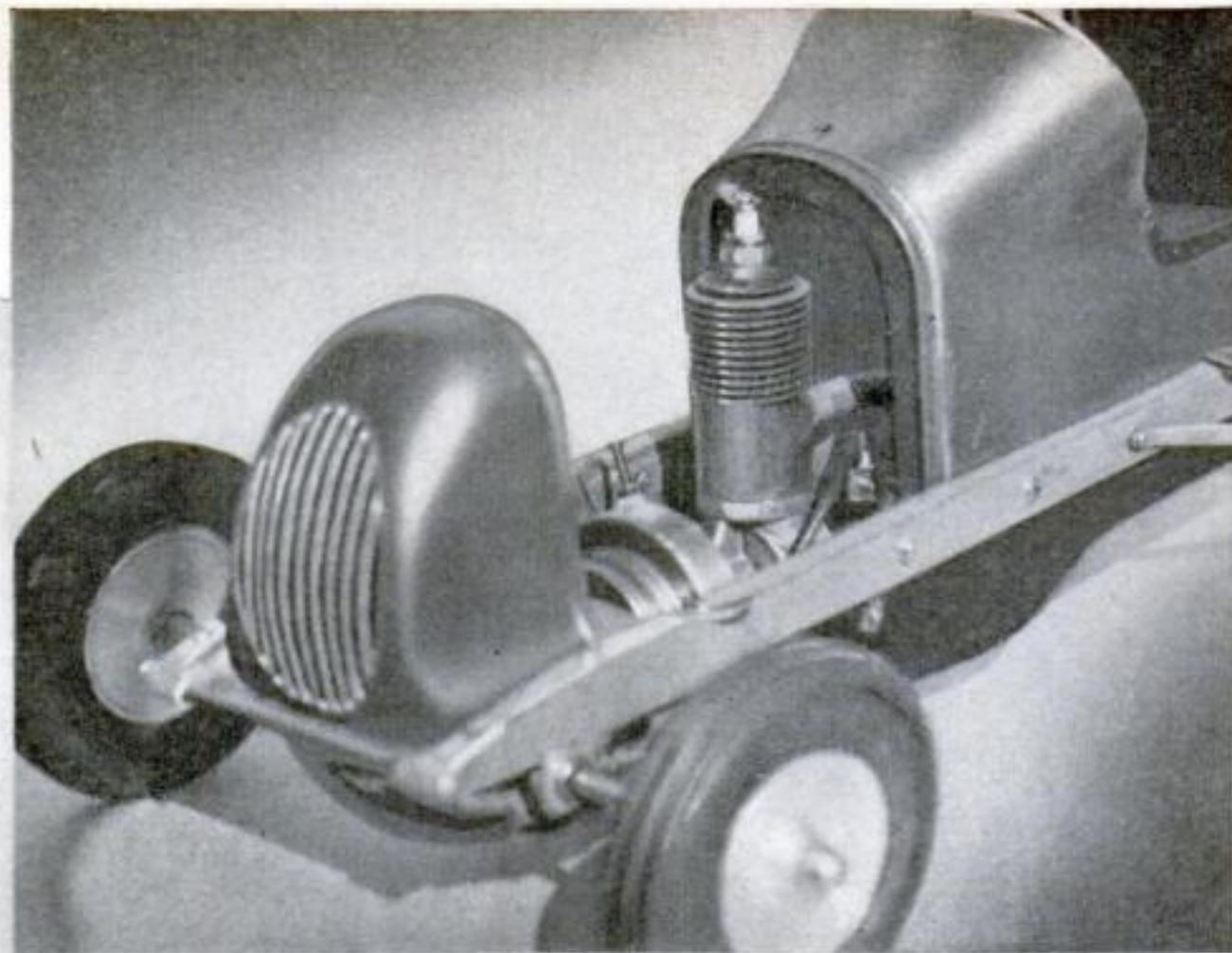


Fig. 9

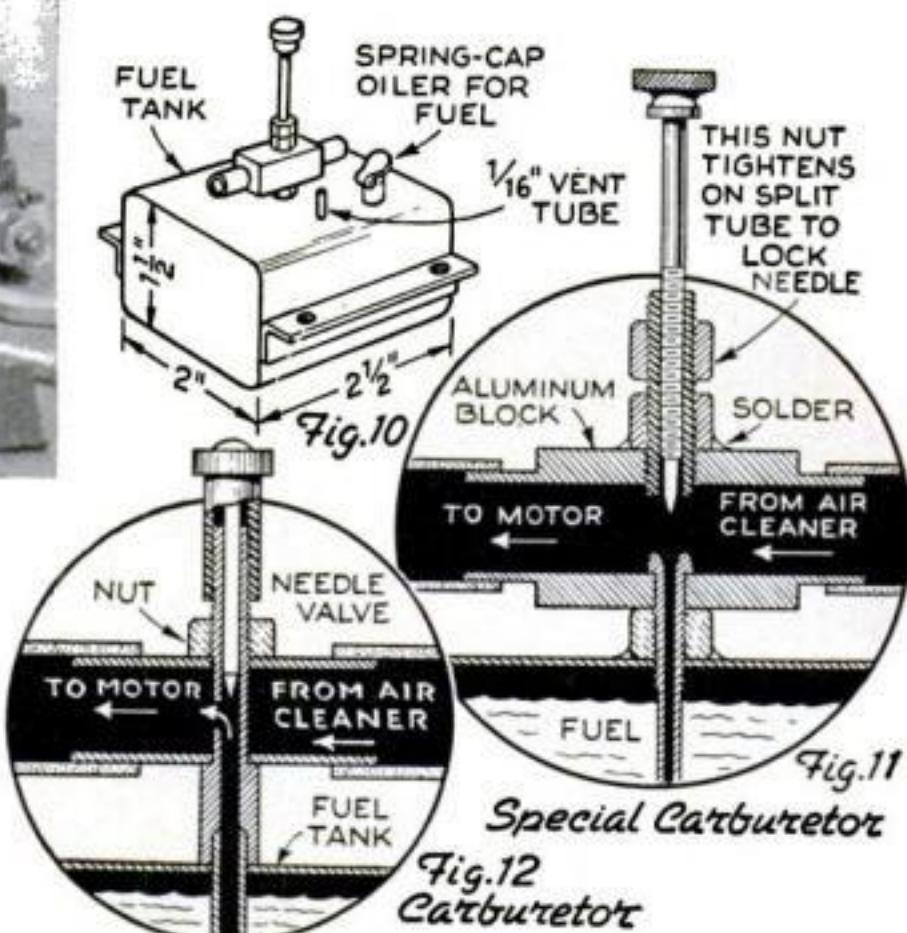
Front end of the midget, showing the motor. Note the metallic-looking finish obtained on the balsa wood by taking great care in filling and rubbing it



Beginning at the front end, a cast-aluminum bracket carries the axle bearings and drive shaft. Bearings are of the so-called "needle-roller" type and add much to the speed of the little car. For experimental or simplified jobs, however, straight aluminum bearings are satisfactory, bored directly in the casting.

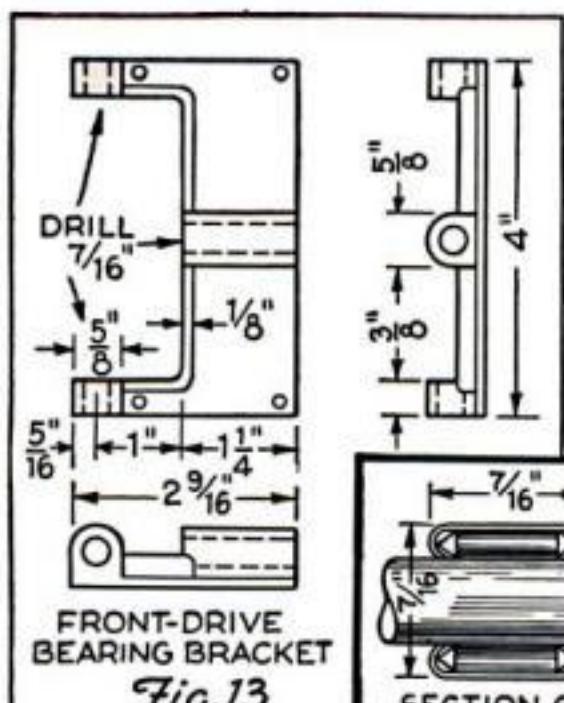
The friction drive is by means of a rubber faucet washer. These are available in several diameters, and by experiment you can determine the size that gives the greatest speed. The "Tiny Tornado" has a power ratio of 1.5 to 1.

Brass angle strips are bolted to the side members, and serve as the motor mounts as well as supports for fuel tank and radio switch. The coil is mounted on a piece of thin plywood as indicated. An air cleaner is installed in the tail of the body. This consists of a tin box filled with common pot-cleaner copper, soaked in oil and allowed to drip until all the excess has been lost before it is placed in the cleaner. *Do not use steel wool; shreds get into the motor and ruin it.* Various other members are secured to the chassis as shown with No. 4-40 bolts.



A trim exhaust pipe may be added, if desired. It should be made of a section of $\frac{3}{4}$ " brass tubing slotted to receive the stack from the engine. A brass streamline plug is set into the forward end, and the other end is cut on a angle. Brass strips secure the tube to the motor stack and body as indicated in a detail drawing. The entire exhaust manifold should be chromium plated for a smart appearance.

All model engines come equipped with fuel tanks, but if you prefer to make your own, a suggestion is given in Fig. 10, which is the same as on the original model. This also has a special carburetor, Fig. 11, which has given an excellent account of itself on the track. However, a carburetor of this type



FRONT-DRIVE
BEARING BRACKET

Fig. 13



Fig. 14

FOR EXHAUST DURALUMIN HOOD

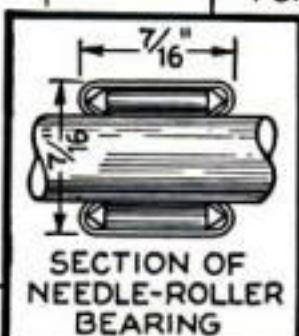


Fig.
15

WIRE RING SOLDERED ON FOR BEADS. PAPER DIALS UNDER CELLULOID. WOOD BACK

Details of the front bearing bracket, special bearings, instrument board, other parts



Fig. 16

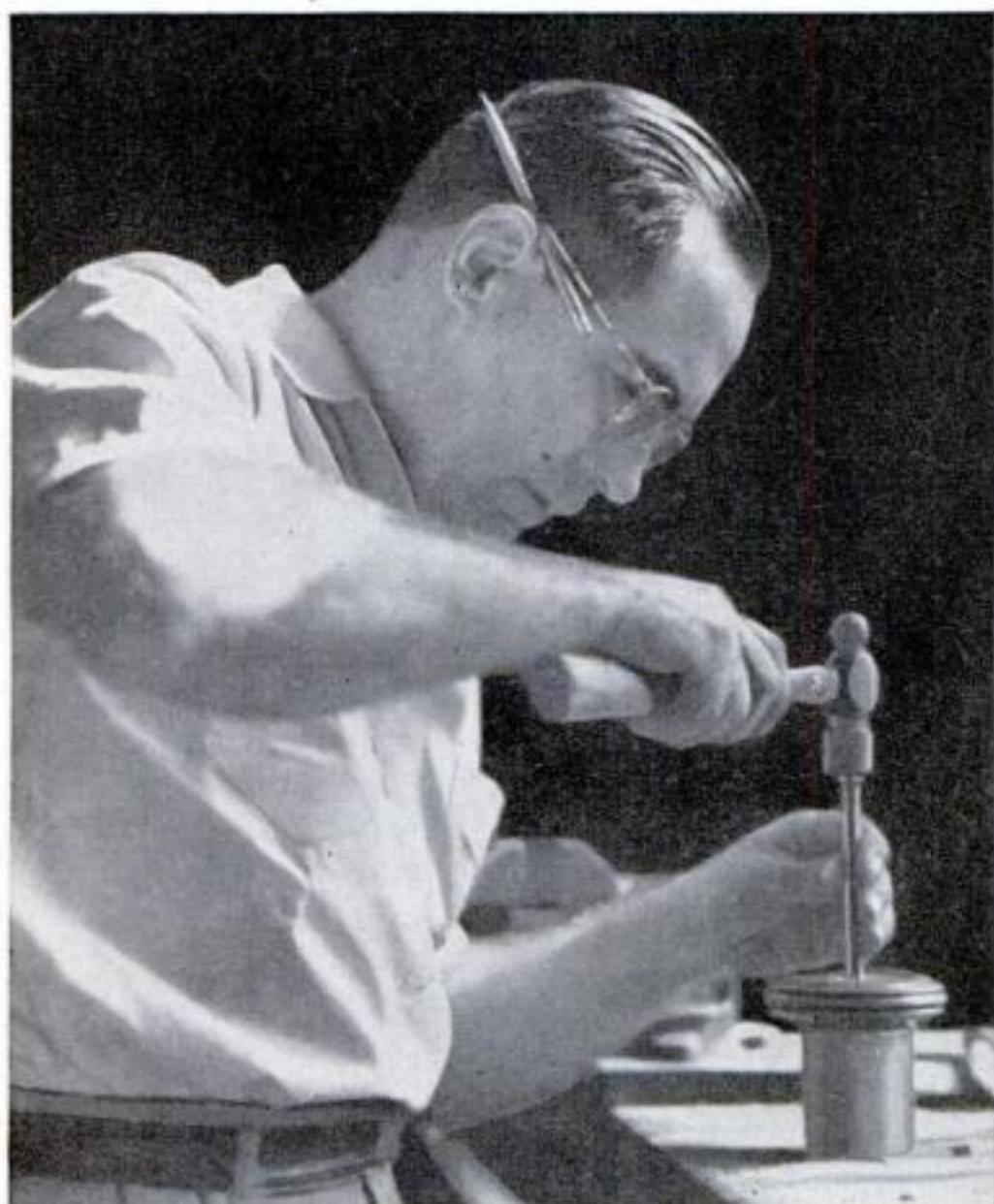
may be a bit too complicated for the novice to try. For beginners the design shown in Fig. 12 is recommended. It is made of standard midget-racer parts and installed on a fuel tank detached from the engine.

In case you wish to make a pattern for the aluminum front bearing bracket, dimensions are given in Fig. 13. Allow enough stock to bore 7/16" for the needle-roller bearings unless you use the plain aluminum ones.

A convincing steering wheel can be scroll-sawed from duralumin as in Fig. 14. Wrap cotton string around the rim, drawing it snug, and apply shellac or enamel. An instrument board adds much to the appearance of the little racer. It may be made of sheet duralumin as in Fig. 15. The dial openings are framed with wire rings soldered in place. Mark the dial faces on Bristol board, cover with celluloid, and back with wood.

Springs are made of steel or spring bronze to the size given in Fig. 18. Only the rear axle is spring-suspended. The hood is shaped to conform to the body and radiator shell, tapering toward the front end. In the original it is held in place by the pressure against the side frames.

Both the seat and the seat back are covered with thin leather. The removable back is illustrated in Fig. 16. It is held in place by a spring clip. The location of the



Peening over the copper-tube bushing in a wheel. At right is a wheel that has been cut away to show its construction

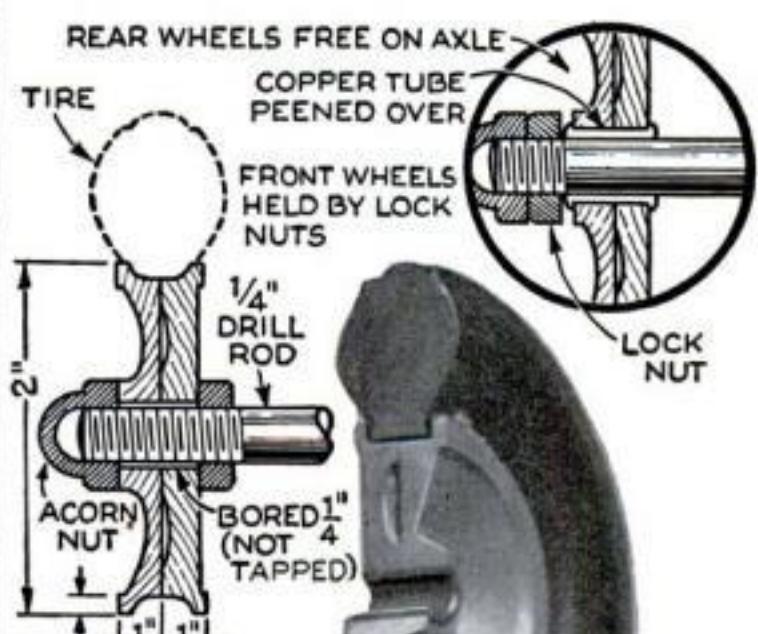
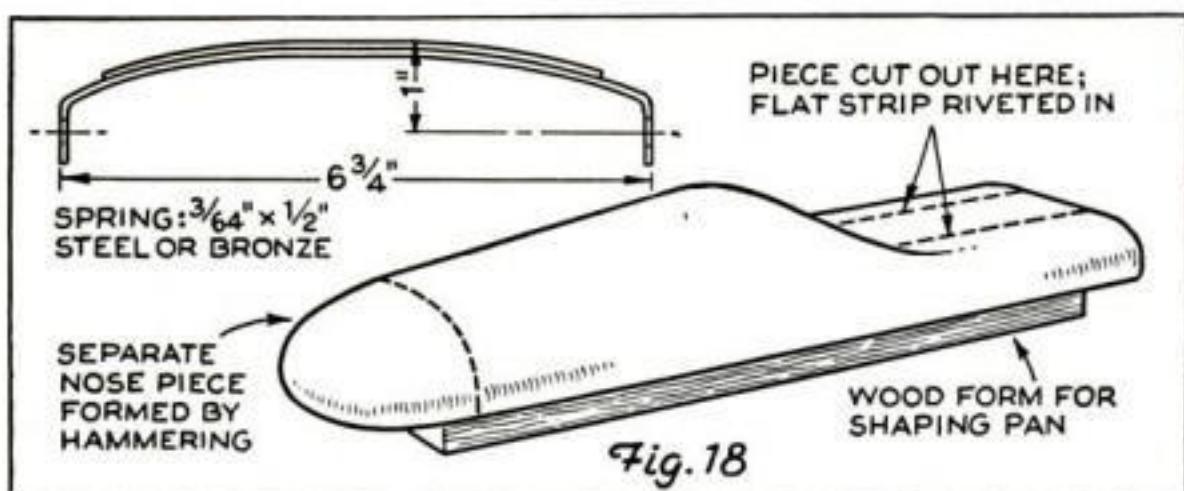


Fig. 17



Form over which the pan is shaped, and detail of rear spring

The appearance is improved by careful painting

battery and air cleaner are also shown.

Wheels are made up of two cast-aluminum disks as in Fig. 17. These are trued on a lathe, the front ones being bored for $\frac{1}{4}$ " drill rod, and the rear for a bushing made of copper tubing, peened over to hold the disks together. The front wheels turn with the axle, being secured with lock nuts. The rear wheels turn freely, and ball-thrust bearings are installed to minimize friction in the inevitable side sway.

For the pan, make a form of wood, Fig. 18, so it can be held in a vise, upside down. The pan is made from aluminum in three pieces, the center piece being formed by rolling the metal with a piece of broomstick.

It will be necessary to cut out a strip at the rear end and rivet in a flat piece. The rounded nose piece is also separate; it is shaped by hammering with a mallet over the form and then riveted to the center piece.

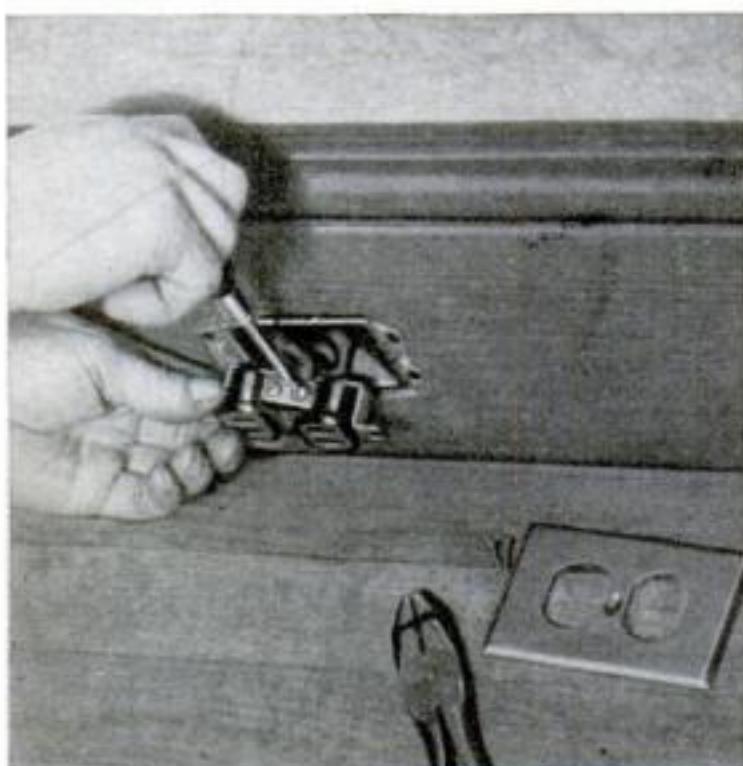
It is possible to achieve a finish on balsa that resembles metal to an amazing degree. Mr. Babb first smooths the raw balsa as much as possible, then applies automobile body filler. This is allowed to dry and is then sanded smooth, whereupon more filler is added. When the surface is satisfactory, he applies two or three coats of airplane dope, allowing each to dry thoroughly, of course, before starting on the next one.

The job is now ready for the finishing coats. Auto enamel is used, but well thinned. It makes a better finish to give four or five coats of thin enamel than two or three of full-bodied consistency.

Before trying out the midget racer, check the bridle connections very carefully. Only one accident is needed to wreck your model completely.

DUPLEX CONVENIENCE OUTLETS

[ELECTRICAL]



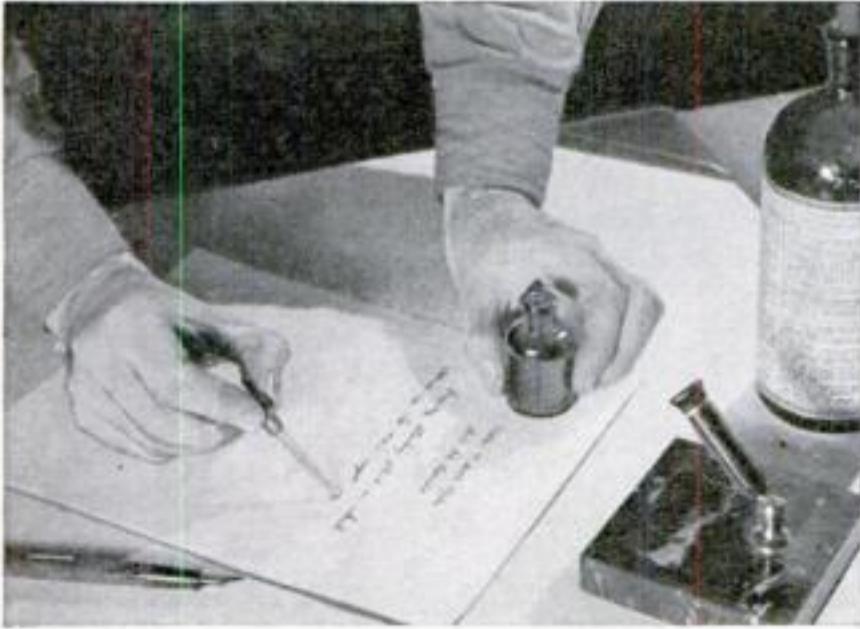
Many base outlets of the single type are in use with double or triple gadgets inserted in them to provide places to plug in extra lights or other conveniences. These should be replaced with duplex receptacles and plates. Shut off the current and remove the old plate and receptacle. Disconnect the wires and connect a new duplex receptacle in the same manner; then add a new double plate. For outlets used for plugging in appliances frequently, use the double-spring contact type, which provides contact on both sides of the attachment cap blades. For outlets used with lamps that are left connected, the cheaper single-spring type will answer.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



Small Trees Uprooted with an Auto Jack

SMALL, undesirable trees can often be uprooted at considerable saving in time and labor by means of an automobile jack and a long beam at least 4" square. The beam is chained to the trunk of the tree as shown and one end is jacked up. The jack is then lowered, the beam loosened and chained to a lower point on the tree, and the operation repeated. Place a board under the beam where it rests on the ground.

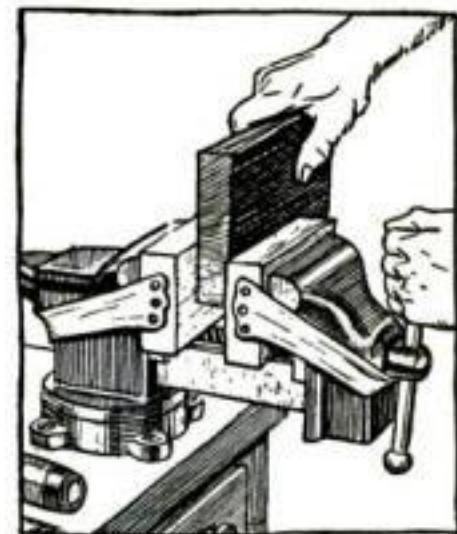


Fluid Removes Ink Marks

LAUNDRY bleaching fluid in which chlorine is the active agent can often be used for removing ordinary ink from paper. Apply a little to the ink, let it act for several seconds, and then take up the excess with a blotter. Repeat if necessary.—W. E. B.

Attaching Wooden Jaws to Machinist's Vise

WHEN a machinist's vise has to be used for holding woodwork, a pair of wooden jaw blocks can be kept in place as shown by using bands of rubber cut from an old inner tube. The bands are slipped over the vise and the jaws.



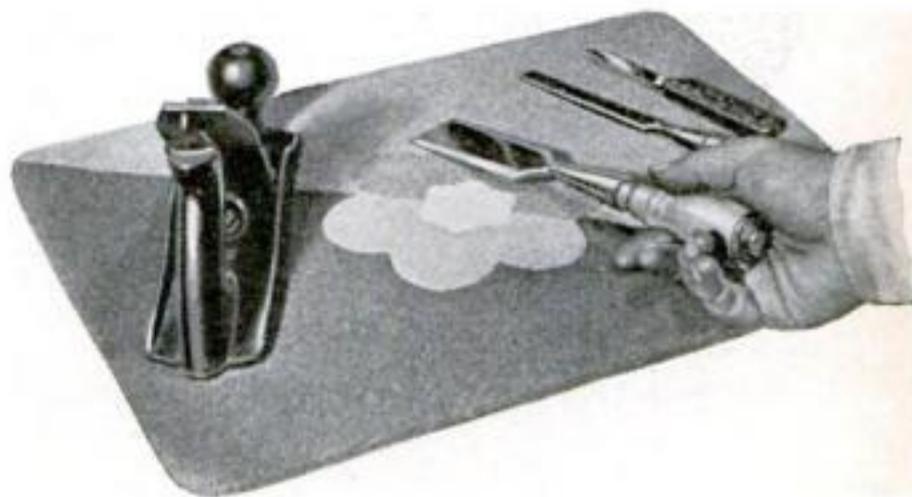
Background Drapes Hang from Battery Clips



HOME portrait photographers can hang improvised background drapes more readily if they provide themselves with two or more holders of the type illustrated at the left. These are made by bolting a battery clip on a picture hanger. Several can be carried in the pocket or in a camera case.—J. MODROCH.

Sponge Rubber Protects Tools Laid on Bench

IF KEPT on the workbench, a sponge-rubber bath mat or kneeling pad is an excellent pad upon which to lay down edged tools temporarily. It is also a good place for small, flat tools, such as steel scales, which are difficult to pick up quickly from the smooth surface of the bench top, or for tools that are likely to roll off of the bench. A suitable pad can be purchased for about twenty-five cents.



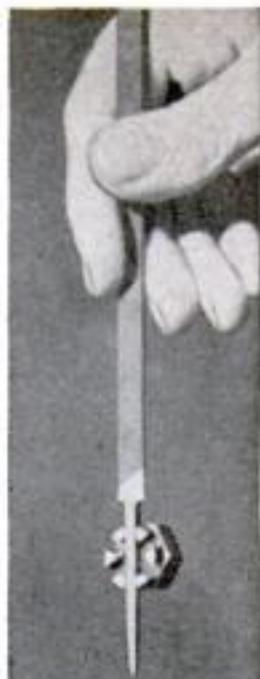


Scraper Removes Sawdust from Band-Saw Tires

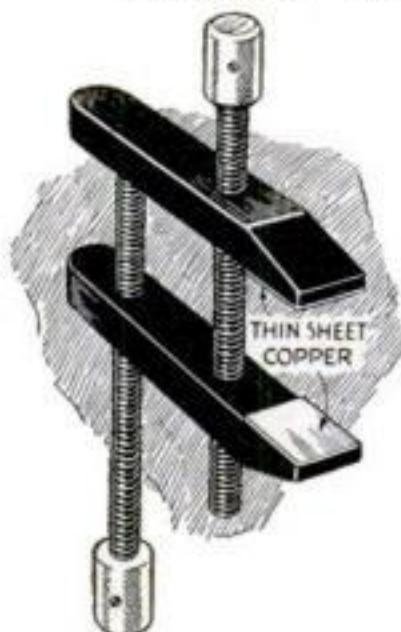
THE sawdust that collects on the rubber tires of a band saw should be removed before it builds up and forms a ridge to throw the blade out of true. A short section of discarded hack-saw blade makes a good scraper for this purpose. The toothed side is moved across the wheel as shown while the wheel is revolved by hand.—H. R. H.

File Tang Holds Castellated Nuts

WHEN one is working in cramped quarters and a number of castellated nuts have to be placed on bolts or studs, the tang of a small file is convenient for holding them. The tang, being tapered, can be wedged into the slots on top of a nut, and one file will serve to hold nuts of several different sizes.—JAMES J. WENNER.



Jaws of Parallel Clamp Faced with Copper



IF IT is necessary to use steel parallel clamps on a finished surface, especially one that is polished or plated, the usual custom is to put paper or soft metal between the jaws and the work to prevent marks or scratches. A more convenient method is to solder thin sheet copper on the ends of the jaws as shown. The clamps are then ready at all times and will hold better without undue strain upon the screws.—CHARLES HOMEWOOD.

COLORED CONCRETE

Color desired	
Black	
Blue	
Brown to reddish brown	
Buff: Colonial tint and yellow	
Green	
Gray: blue-black and black	
Red: bright red to vermillion	
Red: brownish red to dull brick red	
Red: sandstone to purplish red	

Name of color for use with cement	
Black oxide of manganese	
Ultramarine blue	
Metallic brown (oxide)	
Yellow ochre or yellow oxide	
Chromium oxide or greenish-blue ultramarine	
Lampblack (first-quality) or carbon black	
or black oxide of manganese	
or mineral black	
Mineral turkey red	
Red oxide of iron	
Indian red	

Note: Use only pigments resistant to alkali. Mix pigment and cement thoroughly. Figures given above are approximate and may vary depending upon the grade used.

[MASONRY]

Pounds per bag of cement	
Light shade	Medium shade
11	
9	
9	
5	
5	
5	
9	
4	
9	
1	
2	
2	
1	
2	
1	
1	
5	
5	
5	
9	
9	
5	
5	
5	
9	

POPULAR SCIENCE MONTHLY SHOP DATA FILE



Joint meeting of the Spokane (Wash.) Homecrafters and Inland Workshop Club in the shop of C. W. Talbot

Interclub Meetings and Exhibits Encouraged by Guild's Growth

SO MANY home workshop clubs have joined the National Homeworkshop Guild in recent years that several clubs are often to be found within a small radius. A spirit of coöperation has sprung up as a result and interclub meetings are held regularly.

One of the most successful was held recently when the *Spokane (Wash.) Homecrafters* and the *Inland Homeworkshop Club* met at the home of C. W. Talbot, former president of the latter club. A demonstration of power tools was given, and the members voted to have more joint meetings during the coming season.

Last year the *Fall River (Mass.) Homecraft Club* sponsored an outing for home work-

shop clubs of Southern New England, and a similar event will be held this summer. A number of clubs report that their craftwork exhibitions have been attended by delegations from nearby clubs. The *Southeast Woodcraft Club* and *West Cleveland Homeworkshop Club*, both of *Cleveland, Ohio*, held a joint display in a hardware store window.

An ambitious toy project is being undertaken by the *Plow City Homeworkshop Club*, *Canton, Ill.* Secretary D. V. Tolle reports, "Last year we completed 350 toys which we turned over to the *Canton Works Club* for its annual Christmas party. The attendance was 1,500 children, and we are starting to work now so we will be able to make enough



The Lexington (Ky.) Homemakers pose with the 500 toys they made during the past year for distribution among the poor mountain children. In six years they have constructed more than 3,000 toys

for all of them next Christmas. We are to receive the gift of a group of tools because of our participation in this project."

Forty-five members of the *Ware (Mass.) Craftsman Guild* attended its annual dinner. H. R. Connor, Boston representative of an abrasive company, demonstrated uses of oil-

stones and abrasive paper and cloth, and distributed souvenirs. At a regular meeting Fred E. Buss explained how to repair furniture and how to match the stain and finish.

More than 800 persons attended the exhibit of the *Way Homeworkshop Club, Chicago, Ill.* Model ships and trucks, sand molding, sculpture, and furniture were displayed. . . . A cocktail bar, desk, chair, and bookcases are being constructed by the *Shenandoah (Pa.) Homeworkshop Club*. . . . A total of 500 toys were distributed to local orphanages by the *Denver (Colo.) Homeworkshop Club*. New officers are H. S. Alston, president; Arthur A. Bowser, vice president; and George I. Haney, secretary-treasurer.

Approximately 500 toys made in the shops of the *Lexington (Ky.) Homemakers* were distributed recently to eight of the University of Kentucky radio listening centers in the remote sections of the Kentucky mountains. A group of members went as far as two of the listening centers to distribute part of the toys; the rest of the jour-

IF YOU know five other amateur craftsmen in your neighborhood who are interested in the home workshop hobby, you can start a club and become affiliated with the National Homeworkshop Guild. Each club receives free monthly bulletins containing helpful information and job sheets for various types of projects. Complete information will be sent free upon receipt of a large (legal size), self-addressed, and stamped envelope. Just write to the National Homeworkshop Guild, 347 Fourth Avenue, New York, and ask for Bulletin No. 16.

ney was undertaken by E. G. Sulzer, director of the University's listening-center system, and David M. Young, club secretary.

Secretary Allan E. Dye reports that the Kerrisdale Homeworkshop Club, *Vancouver, B. C., Canada*, has completed a very successful year. An outing, a Christmas toy project, and special moving pictures were high lights of the year.

The restoring of old furniture and the making of reproductions have occupied the attention of the Hickory Homeworkshop Club, *Scituate (Mass.)* during the past few months.

A large number of projects were displayed by members of the *Rodeo (Calif.)* Homeworkshop Guild in the hobby show sponsored by the Veterans of Foreign Wars. Several members are remodeling their kitchens.

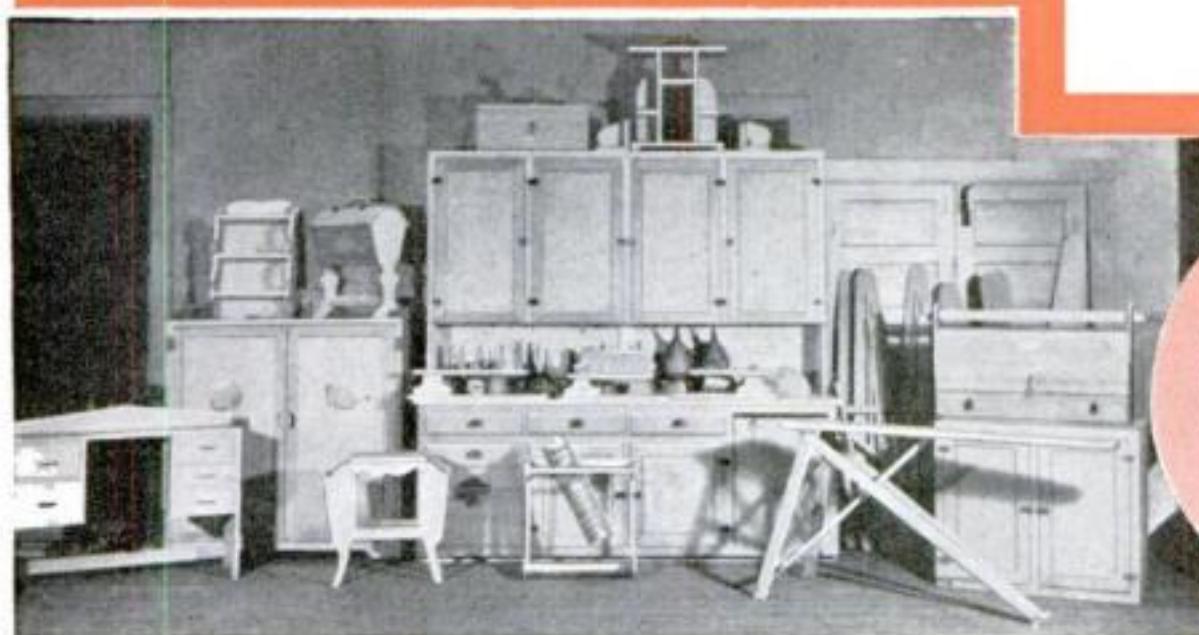
The *Cut Bank (Mont.)* Homeworkshop Club coöperated with the Lion's Club and American Legion in repairing toys to give to poor children of the community... When the *Nemacolin (Pa.)* Homeworkshop Club began its toy project last fall, a number of nonmembers offered to help and they have since joined the club... Because many members come from outside the city limits, the *Galesburg (Ill.)* Homeworkshop Club has changed its name to the Knox County Homeworkshop Club. . . The *New Bedford (Mass.)* Woodcraft Club participated in the local Y.M.C.A. hobby show... Andrew Neubauer has donated two large tanned cowhides to the Eclair Homeworkshop Club, *Cleveland, Ohio*, and a number of leatherwork projects will be undertaken. A series of three-minute talks on shop methods, machinery, and finishes are being given by members at the semimonthly meetings. . . The *West Haven (Conn.)* Homeworkshop Guild is experimenting with new ways to make furniture.

Each year the *Tuscumbia (Mo.)* Homeworkshop Club sponsors a contest for the best Christmas lighting of homes. The idea was rather new for that section of the country and people came from many miles around to see the displays. Last Christmas other towns in the vicinity sponsored similar contests.

Pictures donated by a local calendar company



WHEN the Ohio Valley Home-craft Club held an exhibition several months ago at Oglebay Park, Wheeling, W.Va., one of the outstanding displays was by a wood carver, Max Melhorn. As a boy he planted a willow tree and later, when he became interested in carving, he began using the wood from that tree for his material. The carvings portray the life of Christ. The bottom section shows the birth of Christ and Christ teaching in the temple; second section, the Lord's Supper; third section, Christ's trial, with Pilate washing his hands; fourth section, journey to the Mount and the Crucifixion; fifth section, the tomb and mourners outside the tomb; top section, the Ascension.



Shelves, sewing cabinets, and kitchen furniture made by the members of the Beaverlodge (Alberta, Canada) Club

were used by the *Nutley (N. J.)* Homeworkshop Guild to make 150 jig-saw puzzles for the town's poor children. A power sander has been purchased for the club's shop, which is now almost completely equipped.

The *Crestline (Ohio)* Homeworkshop Club met in the local retail branch of a mail-order store and spent the evening examining and using the power tools on display... A tabulation of the toys made and repaired by the Staley Handicraft Club, *Decatur, Ill.*, revealed that more than 500 were distributed.

In order to complete the ambitious project, the members met every night for several weeks. President E. P. Ecklund was in charge. . . A talk on amateur telescope making was given before the *Seattle (Wash.)* Homeworkshop Club.

An informal exhibit of small projects made by the members was held by the *Wickes (Ark.)* Homeworkshop Club in the workshop of William J. Williams. Mr. Williams gave a demonstration on squaring and gluing picture frames.

Tools and Machines Brightened with Wax Polisher

HAND tools, as well as exposed surfaces of machinery, may be kept clean by stuffing a small paper tube with fine steel wool, over which melted paraffin is then poured. This forms a handy stick polisher, which is rubbed over the tools until they are bright. The steel wool is sufficiently abrasive to remove rust and corrosion, while the coating of wax that is applied at the same time will protect the metal surfaces from moisture.—C. L.



Discarded Hot-Water Tanks Welded to Form Culvert

TO REPLACE a broken wooden culvert, one shopowner obtained a number of discarded galvanized hot-water tanks. After the ends had been cut out, the tanks were welded together as shown.—AUGUST PELLETT.



After the ends are cut off, the tanks are butt welded

Not only was this culvert inexpensive to make, but it will outlast a number of ordinary wooden ones



In spite of its simplicity and low cost, this enlarger can be focused accurately and gives excellent results

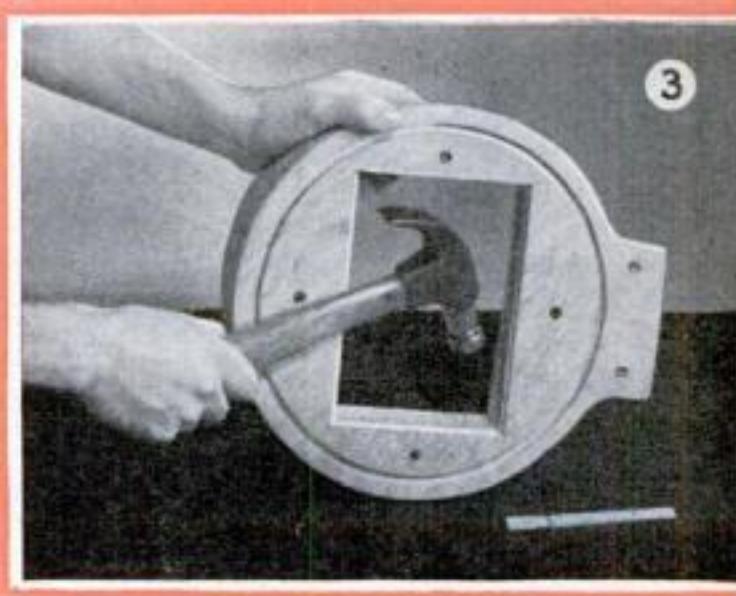
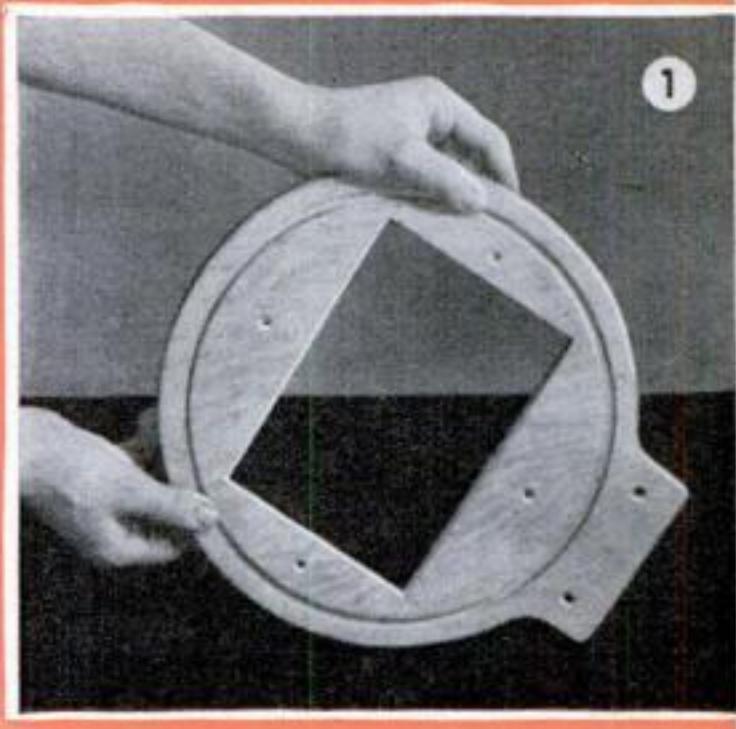
By WALTER HOAG

If YOU own a good focusing-back camera, especially one with double extension bellows, you can use it for enlarging by making an enlarging stand of the type illustrated. Because of the many types of cameras that will serve for this purpose, actual dimensions would be useless; besides, the enlarger is so easily constructed that they are hardly necessary.

The enlarger consists merely of a light source, a negative holder, and a method of varying the distance from the negative to the easel; the camera itself provides the lens and means for focusing.

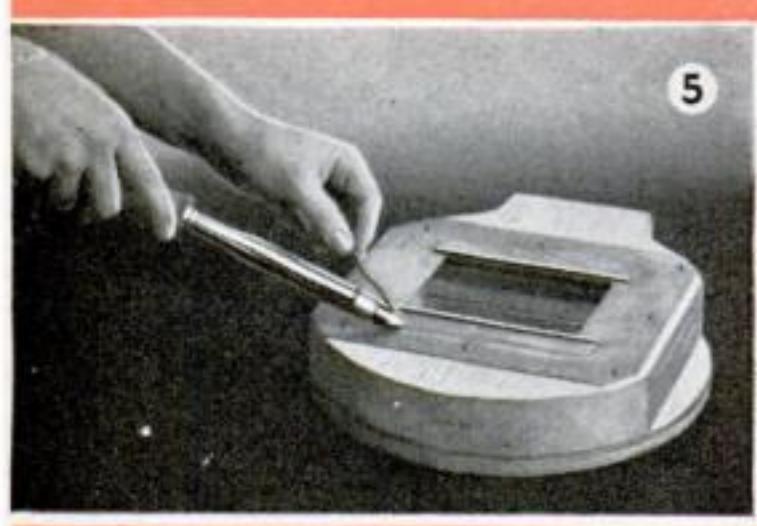
First, select a suitable reflector and make a bottom piece for it from $\frac{3}{4}$ " thick plywood as shown in Fig. 1. This should be grooved to fit

SIMPLY MADE Enlarger FOR USE WITH ANY Focusing-Back Camera





4



5



6



8

the reflector, and the rectangular opening in the center should be cut slightly larger than the negative to be used. Next, make a piece from a 2" thick block as in Fig. 2. Note that this is recessed for the negative holder. Narrow strips of wood are nailed in the opening of the first piece mentioned, $\frac{1}{4}$ " below the top (Fig. 3), to support a sheet of opal glass. The two pieces of wood, the opal glass, and the reflector are assembled as in Fig. 4.

If the camera is of the type using metal holders, a plate of galvanized iron is fastened to the bottom of the thick block, and strips of metal are soldered on to form slides as in Fig. 5. It is then possible to slide the camera into place instantly whenever it is to be used for enlarging. Other types of focusing-back cameras may be fastened to the enlarger with metal hooks made from strap iron or brass as shown in Fig. 6. This photo also illustrates a suitable type of negative holder to use.

The head of the enlarger is mounted on a 4' length of pipe by means of a crowfoot as illustrated in Fig. 7.

Although it was not found essential in the original enlarger, a ventilator may be added as in Fig. 9. Holes are drilled in the upper part of the reflector (Fig. 8) and a light shield or deflector is made from a tin can. A piece of windshield wiper tubing placed over the lower edge of the can will prevent light from leaking underneath when the can is fastened to the reflector with three small brackets.

With this enlarger it is not necessary to use a photoflood bulb. In the original model a 200-watt half-opal lamp is used, and for a normal negative the exposure is about 20 seconds with the lens stopped down to f/8. Judging from the writer's experience, there seems to be no danger that the heat will damage the lens of the camera, even for an exposure of several minutes.



7



9

Protecting Photographs from Paper Clips

WHEN several photos have to be held together with a wire paper clip, an old stunt, although one not known to most amateur photographers, is to cut and bend a strip of discarded cut-film negative to slip over the edge as a protection.—E. V. B.



A bit of old film is bent double and placed over the prints to protect them against the paper clip

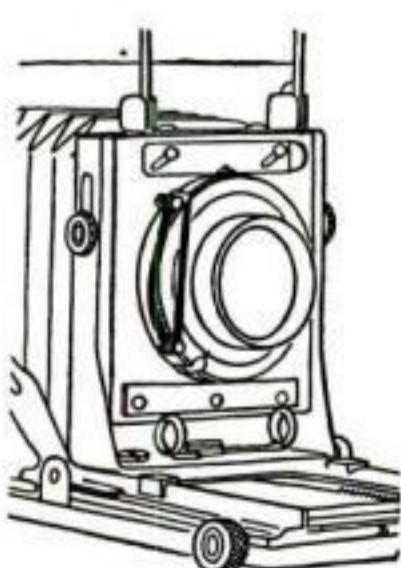
Glycerin Solution for Prints

IF GLOSSY prints dried on an electrically heated print drier have a pitted appearance, try soaking the prints, after they have been thoroughly washed and before drying them, for about five minutes in one part of glycerin to ten parts of water.—LABON BACKER.

Rubber Band Holds Open Front Camera Shutter

IN USING the focal-plane shutter of speed cameras having two shutters, it is necessary that the front shutter be kept open. Sometimes, however, the photographer will accidentally touch the trip lever and close the front shutter without knowing that he has done so. The result is that he goes

on blithely taking blanks. To prevent this, slip a small rubber band over the trip lever and extend it over and around the shutter setting lever, as shown. The rubber band will hold the shutter open indefinitely and prevent the photographer from wasting his film.



Electric Fan Quickly Dries Roll of Film

NEGATIVES can be dried quickly if you first use a film sponge to wipe off the surplus water, then support the film in the air stream from an electric fan. Attach a film clip on each end of the film, use a small loop of string or a rubber band to hold one clip to the wire guard, and fasten the other clip to a nail or hook in the wall.—E. A. B.

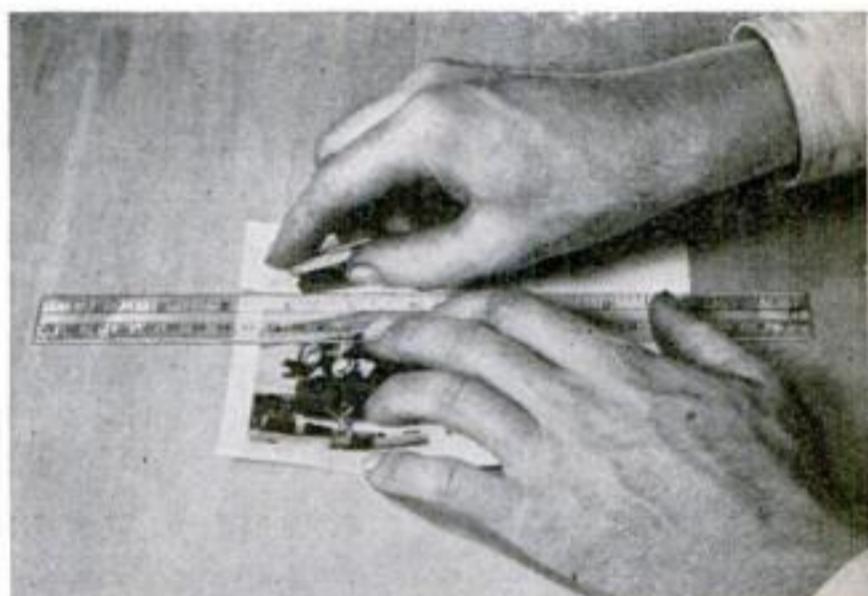


Photo Prints Trimmed with a Razor Blade

THOSE who do not own a photo print trimmer can do a good job of print trimming with a ten-cent celluloid ruler and a safety-razor blade. Lay the print on a board, place the ruler with one of its ruled lines at the edge of the printed part of the picture, and cut off the surplus.—A. T.

Lighting Table-Top Photos

IN MAKING table-top photos, the regular flood and spot-lighting equipment usually throws too much light and does not give a sharp enough spot. Ordinary focusing flash lights are a convenient substitute; they are flexible, cool, and economical.—W. J. V.



Cradle Aids in Loading a Roll-Film Tank

VARIOUS cradles and racks have been devised for loading roll film into the reel of a developing tank, but I have found the most foolproof idea is to use a U-shaped metal strip with two axles as shown above. It is adjustable to all sizes of spools.

In operation, the axles are screwed through the tapped holes in the sides far enough to hold the film spool yet allow it to turn freely. It is then easy to pull the film off the spool and feed it into the reel without danger of scratching or leaving finger prints—GERALD ISERMAN.

Steel Wool Gives Prints Satin Finish

ALTHOUGH glossy paper is favored for snapshot prints, some subjects are more attractive on a matte paper. A pleasing "satin matte" finish can be given to glossy paper by rubbing it evenly with steel wool. The work should, of course, be done on the dry print.



The dry print is rubbed evenly with a handful of medium-grade steel wool

Preventing Drying Marks

"OYSTER-SHELLING," or the appearance of concentric ridges on large, ferrotyped prints, may be largely eliminated by placing a weight on each corner of the print, or by holding each corner down with cellulose tape.



DEVELOPER TIPS

Do not mix in water over 125 deg. F. Higher temperature hastens oxidation of the developing agent. This makes it more likely to stain, and it will not keep as well.

Sulphite preserves the developer by absorbing oxygen, which would otherwise be absorbed by, and oxidize, the developer agent. Too much carbonate will over-energize the developer, upsetting the carbonate-sulphite balance and reducing to silver even those portions of the emulsion that have had little or no exposure to light. Thus, where harder prints are required, reasonable amounts of carbonate may be added for extra energy, plus bromide to restrain the action in the high lights.

Potassium bromide, added to normal developer, is thus also useful when developing outdated papers or film (which tend to fog); also where over-exposure is suspected.

[PHOTOGRAPHY]

Letters Rain Down in Movie Title

A MATEUR cinematographers who wish to inject a touch of originality into their home movie titles will find the following trick quite interesting. Unlike the familiar stunt of having groups of letters suddenly fly into view and arrange themselves in the form of a title, this effect is that of a quantity of letters raining past the view. At intervals certain ones affix themselves at random to the easel to spell out the title.

First cut out a quantity of paper letters by folding sheets of paper in sixths and cutting them six at a time. For the easel, stretch a sheet of black paper over a frame of wood, and on it lay out the letters necessary to spell the title. The letters are held by piercing them with straight pins through the back of the easel. The easel is then placed upside down in front of the movie camera.

Start by shooting about a foot of the title. Then drop a few letters past the title, gradually increasing the number. As they fall past the title, pull the pins out from behind the easel, one by one at intervals, selecting them at random. As each pin is removed, the corresponding letter on the opposite side of the easel is released and it falls with the rest of the raining letters. After all of the pins have been removed, allow a few



As the paper letters rain past the camera, pins holding the title in place are pulled out

more letters to rain past the easel and then gradually cut down the amount until no more are falling, and stop the camera.

When developed the title should be cut from the film and spliced back in again after turning it end for end. The result, when projected, will be the reverse of what was photographed. The letters will gradually start raining down and as they fall some will stop to spell out the title. Then the rain of letters will thin out until it stops, leaving the title clear.—LOUIS HOCHMAN.

PRINT CONTROL DURING PROJECTION

[PHOTOGRAPHY]

Diffusion: To obtain softer, more artistic results. Obtained by bringing some thin fabric or similar material between enlarger lens and paper during all or part of the projection time.

Dodging: Holding back projection light from portions of the print that would print too dark. A foreground, for example, may be held back to permit the sky to print up. Remember it takes double the photographic exposure to make much apparent difference.

Spot Printing: This is the opposite of dodging. Areas printing too lightly are allowed additional light through an aperture cut to the desired shape in any opaque paper or card. Accenting the eyes of a portrait with a little spot printing is often quite an improvement.

In both dodging and spot printing, keep the shading card moving slightly to avoid any harsh edges except where the area has a dark, sharp outline to start with.



Touching up the worn spots on a fiber chair with a walnut-colored lacquer shade coat before spraying on clear lacquer



FINISHING Fiber and Willow Furniture

SO-CALLED "fiber" furniture is woven from material that consists of a mild steel wire core covered with heavy, hard-twisted paper stock. So long as this is adequately protected and finished, just so long will it prove durable.

Perhaps the best material for sizing this weave is a solution of 8 oz. casein glue properly swelled with cold water as in standard

gluing practice and then made up to 1 gal. with hot water. If the work is new, from 2 to 4 oz. of water-soluble walnut, mahogany, or other stain powder can be added to each gallon of sizing to form a

suitable stain solution. This can best be sprayed on, but may also be poured or brushed on while the piece stands in a galvanized tub, tray, or other catch basin from which the excess stain can be taken for further use.

This sealer must be dried thoroughly in a warm room for about forty-eight hours and may then be recoated to obtain a darker ef-

fect or finished with clear spraying lacquer, varnish, or quick-drying enamels. In case enamels are used, the sizing coat is, of course, prepared without any stain.

Later, when usage has knocked or worn off limited areas, these may be retouched with a walnut shade coat made on a lacquer base.* If a spray gun is at hand or even a hand-pump sprayer such as is used for garden work (it must be carefully cleaned), the whole area can be shaded out and then given one or two coats of clear lacquer or varnish.

Woven work of this kind is best handled by a sprayer since hand brushing requires great care. The brush tends to wipe off the outer surfaces too thin for durability, but piles up the finishing material in the twists and cross weaves. Spray application, on the other hand, lays on a heavy coat on the outer surfaces and a minimum amount within the weave where it is not needed.

All spraying should be done as nearly *parallel* to the surface of the weave as possible. The work

*Dissolve $\frac{1}{2}$ oz. oil-soluble walnut stain powder in 1 pt. lacquer thinner. Blend $\frac{1}{4}$ pt. orange shellac and $\frac{1}{4}$ pt. shellac-mixing lacquer or wood lacquer, and add to the first mixture. Strain and thin further if necessary for spraying.

By
RALPH G. WARING



Above, use only clear floor varnish for coating genuine rush seats. At left, painting a basket-weave panel with a small brush. Note the thumb palette

should be done entirely from the left-hand position and then reversed to return from the right hand. Do the out-of-sight portions first and end with the most prominent.

Where colored enamels are used, two coats will be necessary to get good coverage, and in the case of white or other very light coats, three may be needed. Ornamental designs may be had by spraying through a stencil, but better and cleaner work on rope twists or basket weaves is obtained by cutting in by hand, as shown.

Many two-colored effects—such as forest green over bright orange—are possible. Lay on the ground color and let dry hard. The next day quickly brush on the overtone color, then wipe off with rags until the desired values are obtained. Ivory with an antique glaze of raw sienna and a touch of French ocher gives a very fine effect if the glaze is wiped out strongly to leave but a sug-



For a two-tone effect, an enamel of another color is glazed over the first

gestion of color. Let dry hard and then protect with a coat of eggshell varnish. Regular varnish should be avoided because the glossy finish has a cheapening effect.

If the furniture is willow instead of fiber, beautiful clear tones are obtained by first thoroughly scrubbing the furniture with a hot solution of 4 oz. of washing soda in 1 gal. of water. This cuts the natural glaze of the weave and forms a toner coat on which subsequent stain coats may be used to get even coloring. Clear stained effects in blue, red, brown, yellow, walnut, or mahogany—in fact, in any clear dye color—can be produced on willow so treated. Light colors, such as are made by using 2 oz. of powder to 1 gal. of water, give fine,

The overtone color is then wiped off with rags to reveal the enamel beneath



clean shades. These should be protected with clear lacquer coatings, which are free of the yellow cast typical of varnishes.

Genuine rush seats, unlike the other materials, should be coated only with clear floor varnish. If this is applied with a brush, make all the strokes in the direction of the weave, not across.

In the absence of commercial shop equipment, good work can be done at home with any high-grade $\frac{1}{4}$ -h.p. portable sprayer. Where the garage or some spare room is used for this work, get rid of all possible dust first; air out the room; sprinkle the floor; allow for adequate ventilation while working, and avoid spraying in any location where the spray mist or fumes may reach a basement furnace, gas water heater, or garage stove.

Adjust the weight of the material (that is, the thinness or thickness of the liquid) to balance with the available air pressure by using the thinner or reducer recommended by the manufacturer of the lacquer, varnish, or enamel being used. See to it that the material is well strained through double cheesecloth and that the spray gun has been thoroughly cleaned and adjusted. Lay on thin, even coats and allow plenty of drying time between applications so that each coat is well hardened before applying the next.

The amateur can finish reed the same as willow. In commercial practice, however, a more difficult practice is often followed. The entire piece is gone over rapidly with a blowtorch. If it is to be finished natural or light, it is dampened with steam in a box, taken out, and put in another, where it is subjected to a bleaching action from burning sulphur. Then it is removed and dried, and later coated with shellac or furniture varnish applied with a gun.

Cotton Glove Prevents Smudges on Pencil Drawings

SOME artists and draftsmen are troubled with excessive perspiration of the hands. This is especially annoying because it results in smudged drawings, and time must be taken to clean them up. I find that a cotton glove cut off as shown aids in keeping the drawings clean, yet does not interfere with pen or pencil.—W. A. PATRICK.





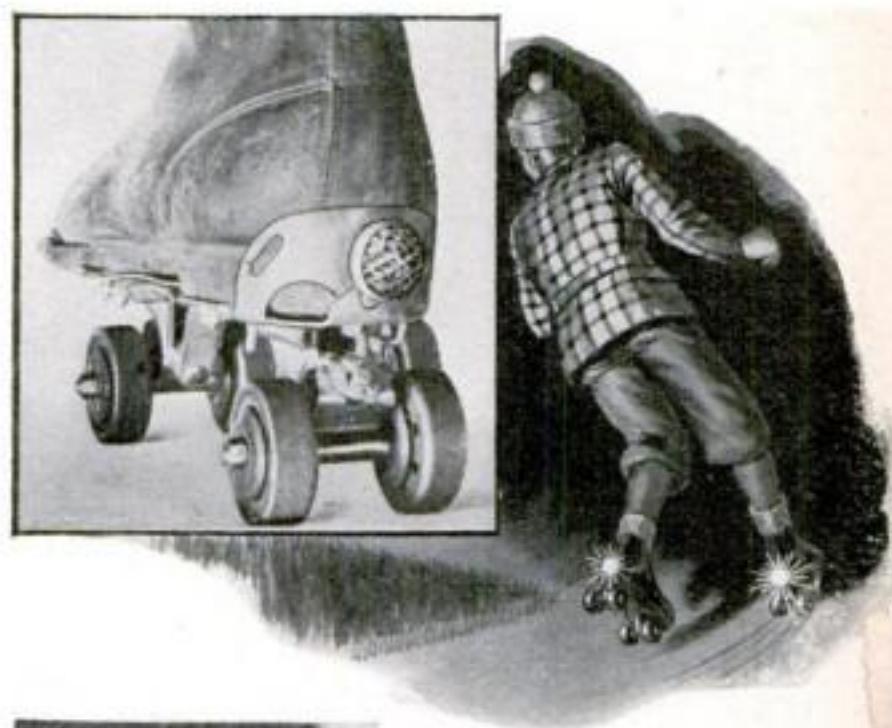
Old Hoe Welded on Rake to Cut Stray Weeds

AN OLD, broken hoe welded to the back of a rake as shown saves work because you do not have to stop to get a hoe every time you come across a weed that was missed when you were hoeing. Many small shops will do this welding for twenty-five cents or not much more.—RAFFIE BERBERIAN.

Subscribers are requested to notify us of change of address four weeks in advance of the next publication date. Please give both old and new addresses.

Roller-Skate Tail Lights

AN ENTHUSIASTIC skater who does considerable roller skating in the evening mounted reflector buttons, such as are attached to auto-license plates, on the heel plates. Besides serving a practical purpose, these "tail lights" proved quite a novelty to the skater's friends.—C. C. COOLEY.



Tape Covers Oil Holes

STRIPS of transparent cellulose tape stuck over the oil holes of woodworking machines will keep out sawdust and dirt.—H. H.

MOTORS—FULL-LOAD CURRENT

[ELECTRICAL]

The following table gives the average full-load current taken by the common types of single-phase motors. The starting current, however, will be somewhat higher for the brief period it takes for the motors to come up to speed.

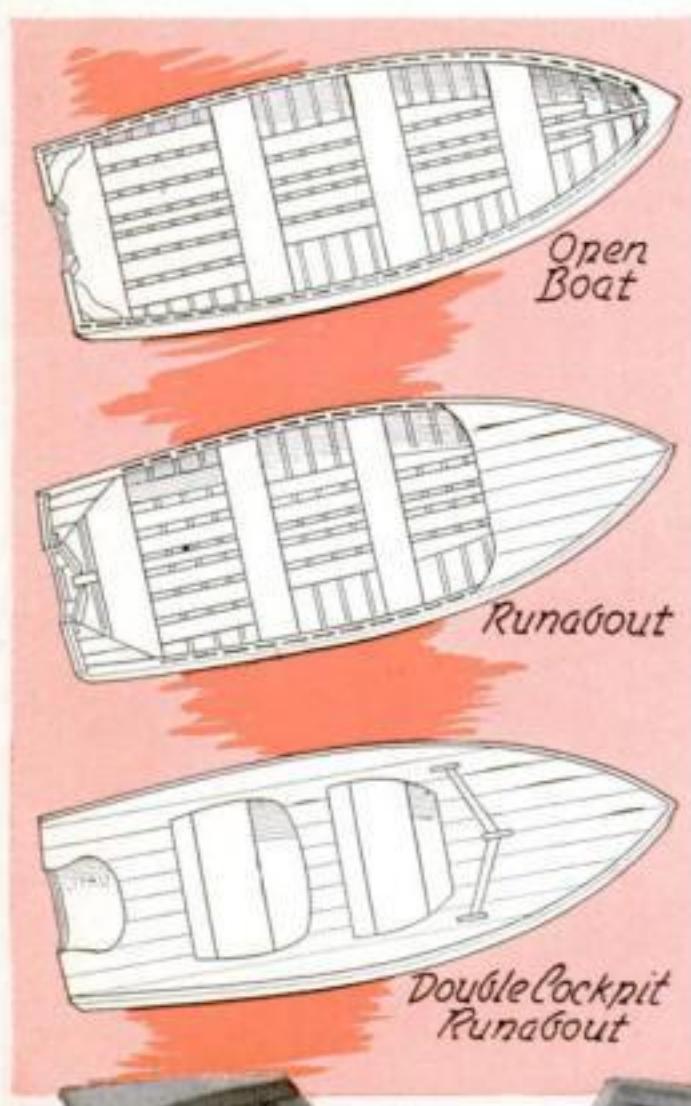
Horsepower	115 volts	230 volts
1/6	3.34 amperes	1.67 amperes
1/4	4.8 "	2.4 "
1/2	7 "	3.5 "
3/4	9.4 "	4.7 "
1	11 "	5.5 "

For protection of motors, it is recommended that a small circuit breaker or thermal relay be used in the circuit. This allows the branch circuit fuses to be large enough to take care of the starting current, but on overload or short circuit, the breaker will open and protect the motor against burning out.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

WE GET READY TO LAUNCH OUR NEW

Family



Deck and seats of this 13½' boat may be arranged in any manner desired provided the sides and keel are well braced

BEFORE the ribs of our new round-bottom utility runabout can be bent and fastened in place, they must be soaked in water for a day or more, then steamed thoroughly in the box described in the previous installment. Using gloves, take them out one at a time and place as quickly as possible. The ribs are run in one piece from gunwale to gunwale wherever possible, and the planking is fastened to the ribs through the laps only. Use 1" No. 7 screws or copper rivets. Hold the ribs from spreading with cord as shown until the deck and seats are all in position.

The ribs may tend to push the keel down, causing a rocker curve. If a high-power motor is to be used, this will spoil the performance, so the keel should be kept perfectly straight fore-and-aft from the transom to a

point midway between stations 3 and 4. The keelson can be braced to the seats, and the seats to the gunwales, if necessary. A slight reverse curve in the after section of the keel line will do no



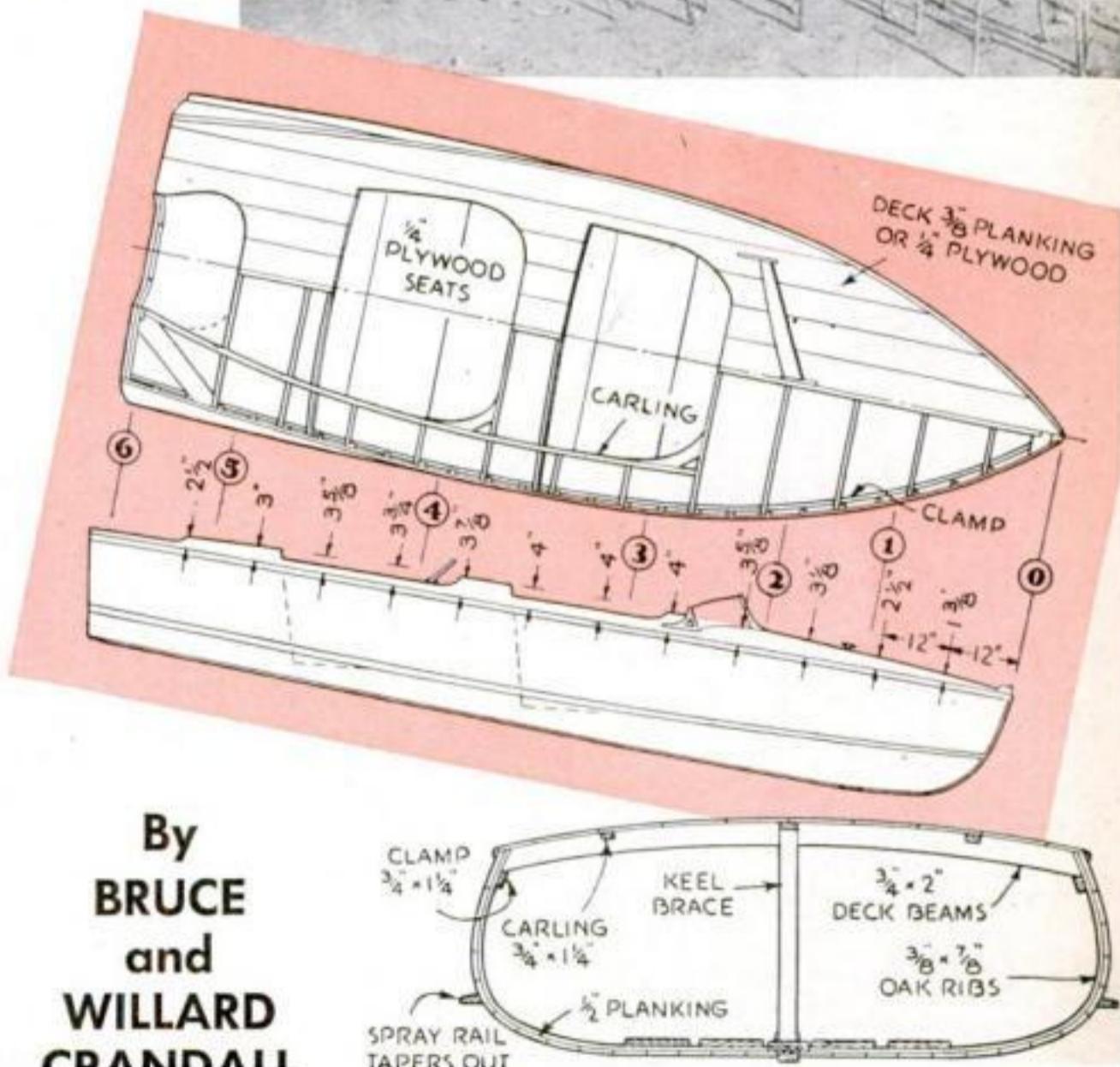
Runabout

PART THREE

harm. The bevel cut at the extreme aft end of the keel is to prevent any rooster-tail spray.

If the boat is to be *smooth-built*, the ribs must be put in before the planking is started and before the keel is in place. About $\frac{3}{4}$ " by 1" pieces called "ribbands" are placed lengthwise over the molds and spaced about 6" apart; they are temporarily fastened to the molds, stem, and transom. Notches are cut in the keelson for the ribs to pass through. Then the ribs are all bent into position under the ribbands, placed in the notches in the keelson, and temporarily fastened to the ribbands by any method desired. Next, the keel is fastened in place, and the ribbands are removed one at a time once the planking is fastened to the ribs.

Calked-seam construction is most satisfactory from the standpoint of long life and easy repairs, including plank replacement, but it should not be used with a large motor in rough water. About fourteen planks of $\frac{1}{2}$ " cedar should be used on each side, and all the planks can then be made from 4" to 6" stock. Where the sharpest bends occur, some planks from $\frac{3}{4}$ " stock may be required, hollowed on the inside to fit the contour of the ribs and transom. Screws or copper rivets can be used to fasten the planking to the ribs. All planks should be fitted tight on the inside, with the seams open approx-

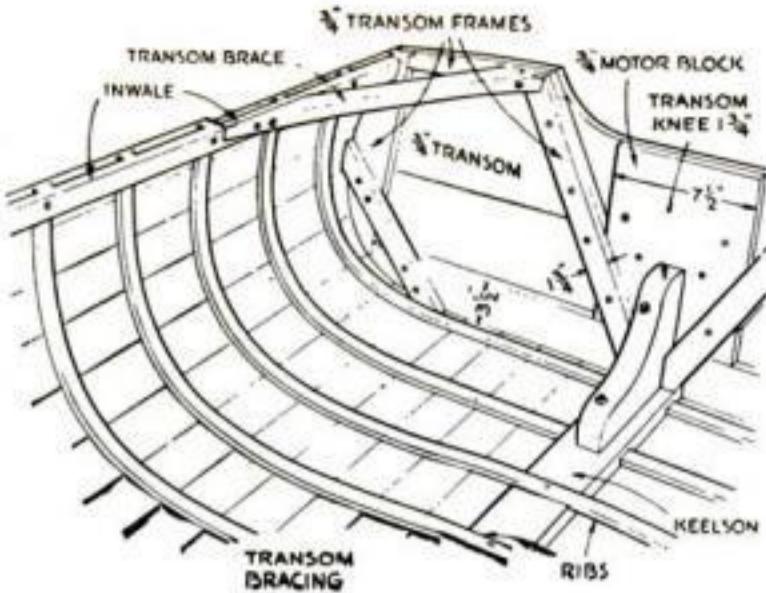


By
BRUCE
and
WILLARD
CRANDALL

CROSS SECTION OF ABOVE AT STATION
NO 5 - CALKED-SEAM CONSTRUCTION



imately $1/16$ " on the outside. Several strands of cotton wicking are used for calking and covered over with putty or seam composition. For additional strength, intermediate

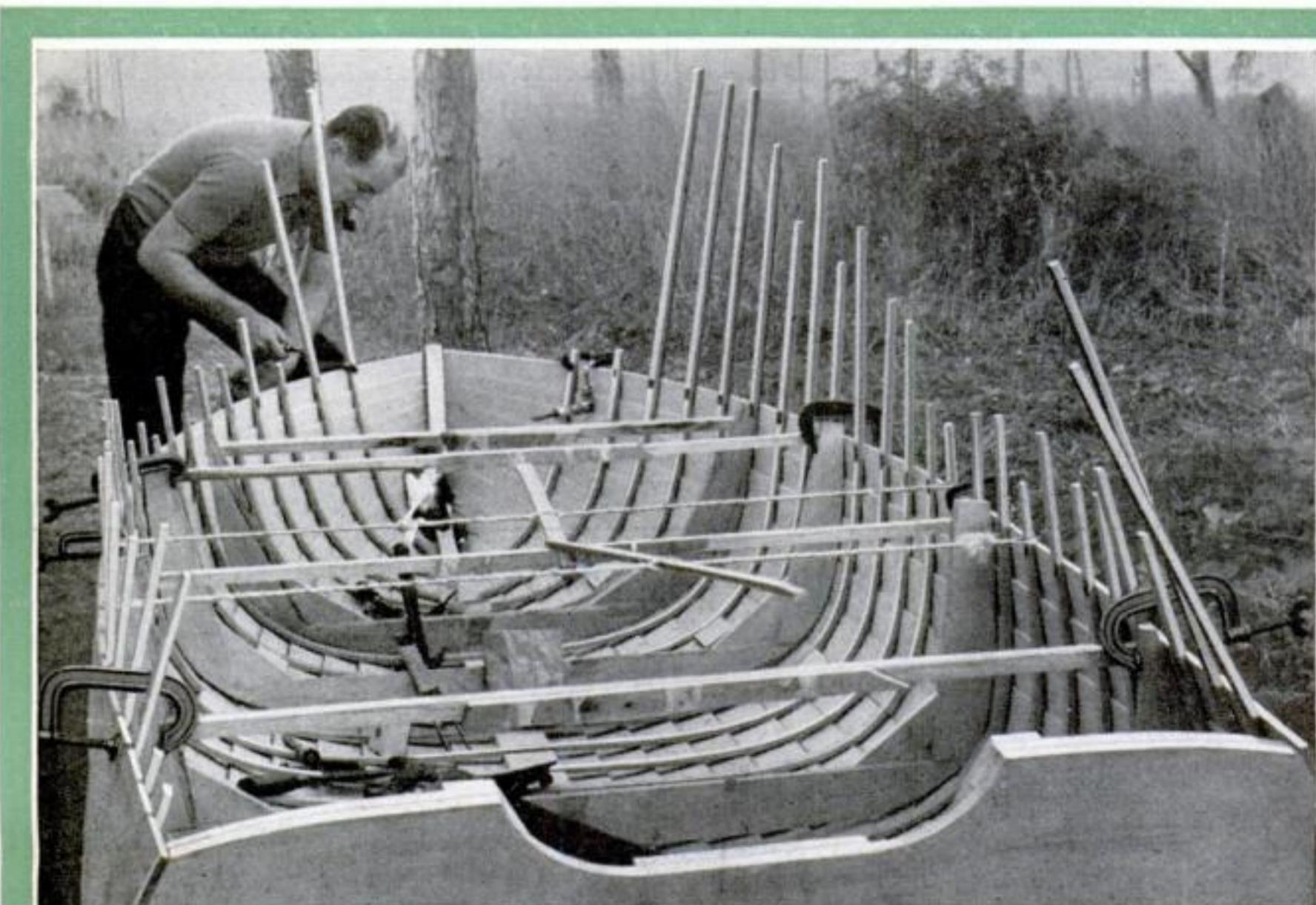


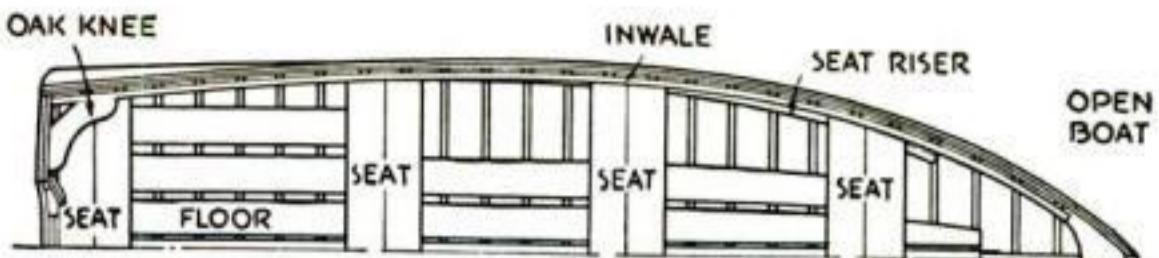
Each steamed rib is bent quickly into place before it has a chance to cool off

"half-ribs"—across the bottom only—may be put in after the boat is right side up.

For *compressed-seam* or *strip* construction, cedar strips about $1/2$ " by $3/4$ " are used, and planking is started at the sheer. Each strip is clamped to the previous one with chain clamps, nailed edgewise to the previous strip, and screw-fastened to the ribs. If the strips are not tapered toward the bow, a large irregularly shaped plank may be necessary to fill out near the keel. No calking is necessary.

Canvas-covered construction is ideal for light weight and freedom from leaks. Oak





A half plan view showing the arrangement used for an open boat without deck

ribs $\frac{3}{4}$ " by $\frac{1}{4}$ " should be used, spaced about 3" apart. Resawed cedar $\frac{1}{4}$ " by 3" or 4" is then used for planking, which is fastened to each rib with small copper nails, well clinched so that no heads will protrude. The entire hull must then be sanded smooth.

The canvas — either 12- or 14-oz. duck—is best put on in one piece, cut back only as far as necessary from the bow and lapped over and tacked securely to the stem. It may be tightly stretched over the hull by tying it at intervals along the sheer with double cords fastened to the floor. These cords are tightened more each day by

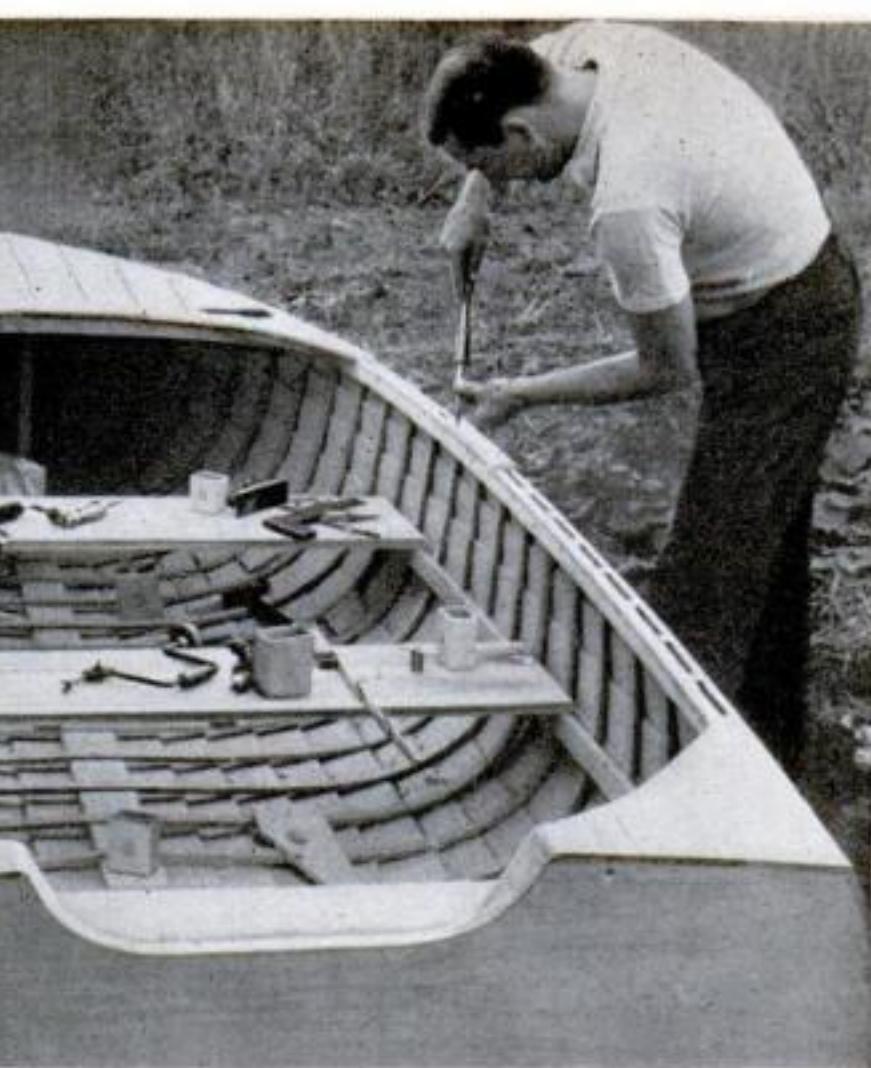
Transom braces are essential even if a small motor is to be used. The ribs are neatly sawed flush with top of inwales



twisting them, until the canvas is stretched to shape. It is then tacked securely all around the sheer and at the transom. A smooth, waterproof surface is built up by successive coats of filler, each sanded down; several coats of flat paint, and then spar varnish. Where the canvas is tacked to the transom, it should be protected with a thin brass strip screwed to the transom.

Before starting work on the deck and seats, the breasthook should be installed and the sheer line carefully trued up. The deck and seats may be arranged in any manner desired that will provide for properly bracing the sides and keeping the keel line straight. If a high-crowned deck is used, as shown in drawing of the double-cockpit style, the curve of each deck beam must be laid out separately. Otherwise, the sizes given are approximately right.

A very important point is that the transom must be properly braced at the top as illustrated, or in some similar manner. The half-round sheer molding should be clamped in place before fastening, to check for a true curve. Full-length spray rails will help to keep flying spray out of the boat if smooth-built construction is used. These rails are fastened through the ribs from the



The ribs have a tendency to push out the sides, but this is controlled with cords, as shown in previous photos, until seats and deck are in

inside with long screws. The stem should be protected by a stem band of half-oval brass or of galvanized iron. Before starting to paint the hull, dress down the stem to leave only a $\frac{5}{8}$ " surface to which to fasten the stem band.

The entire hull should be well sanded and all screw holes covered with putty. Lay out the water line by placing the boat level on an even floor and marking all around 6" up from the floor. The hull should have at least two coats of marine enamel after the priming coat of paint, or it may be finished with several coats of flat paint followed by one of spar varnish.

MATERIALS FOR VARIOUS TYPES OF CONSTRUCTION

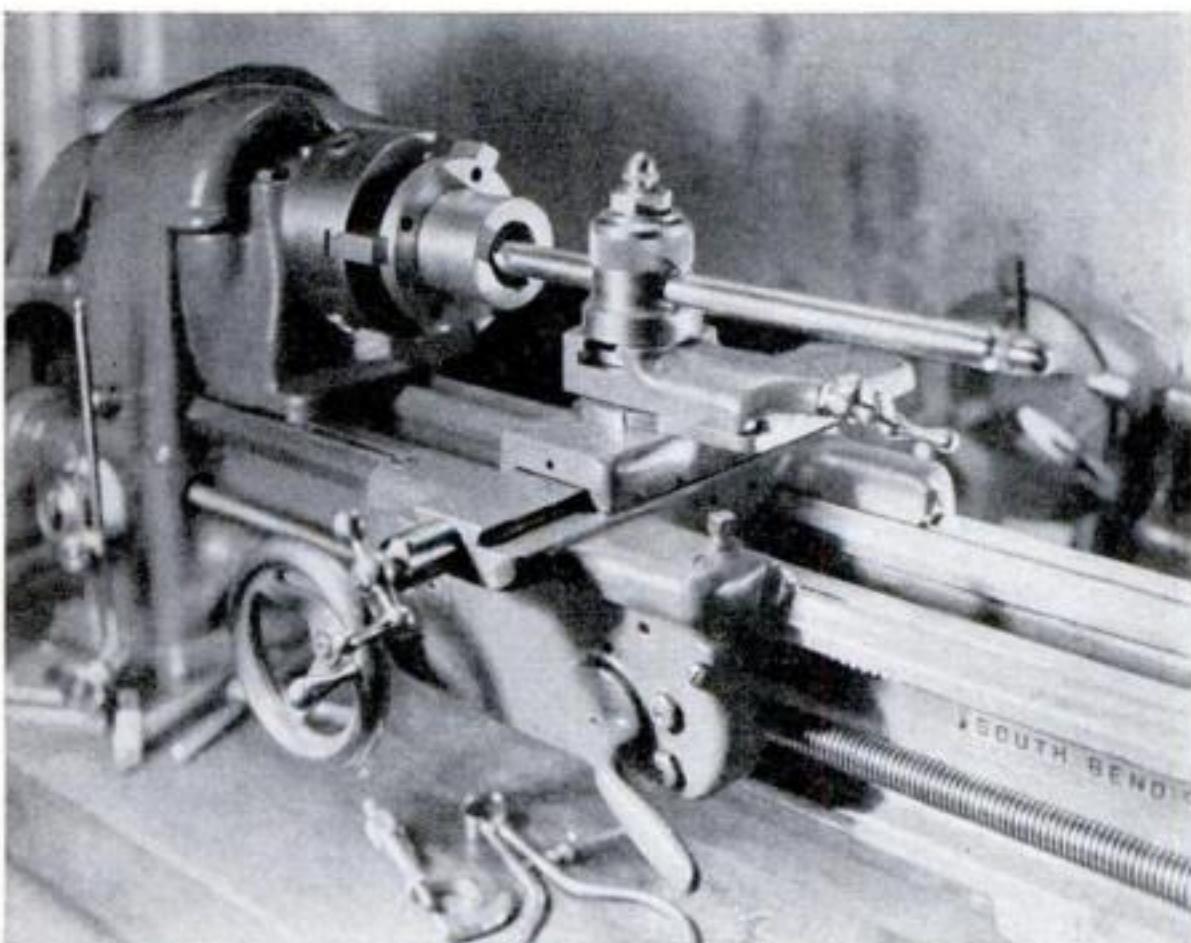
For any other construction than lapstreak, the following changes must be made in the original list of materials:

Smooth-built: Add—for ribbands, 14 pc. $\frac{3}{4}$ " x 1" x 14', any cheap lumber. *Calked-seam:* Substitute—for planking, 18 pc. $\frac{1}{2}$ " x 4" x 14', 14 pc. $\frac{1}{2}$ " x 6" x 14'. Add—for calking, 6 balls cotton wicking. Eliminate—4 lb. 1 $\frac{1}{4}$ " nails or 3 gr. 1" No. 7 screws (either one, as desired). Change—marine glue to only 1 qt. *Strip construction:* Substitute—for planking, 100 pc. $\frac{1}{2}$ " x $\frac{3}{4}$ " x 14' cedar, 2 pc. $\frac{1}{2}$ " x 6" x 12' cedar; for 3 gr. 1" No. 7 screws, 16

gr. $\frac{7}{8}$ " No. 7 screws. Add—10 lb. 1 $\frac{1}{4}$ " nails. Change—marine glue to only 1 qt. *Canvas-covered:* Substitute—for planking, 18 pc. $\frac{1}{4}$ " x 4" x 14' and 14 pc. $\frac{1}{4}$ " x 6" x 14', or 2 pc. $\frac{1}{8}$ " x 4' x 14' waterproof plywood; for ribs, 50 pc. $\frac{1}{4}$ " x $\frac{3}{4}$ " x 8' white oak; for 4 lb. 1 $\frac{1}{4}$ " nails, 4 lb. 1" clout nails. Add—12- or 14-oz. duck, 1 pc. 90" x 14'; copper tacks, $\frac{1}{2}$ lb. $\frac{1}{8}$ " or $\frac{3}{8}$ ". *Double-cockpit arrangement:* Add—for deck beams, 1 pc. $\frac{3}{4}$ " x 10" x 14'; for decking, 8 pc. $\frac{3}{8}$ " x 6" x 14' or (for decks and seats) 4 pc. $\frac{1}{4}$ " x 4' x 8' waterproof plywood; also fastening and fittings as desired.

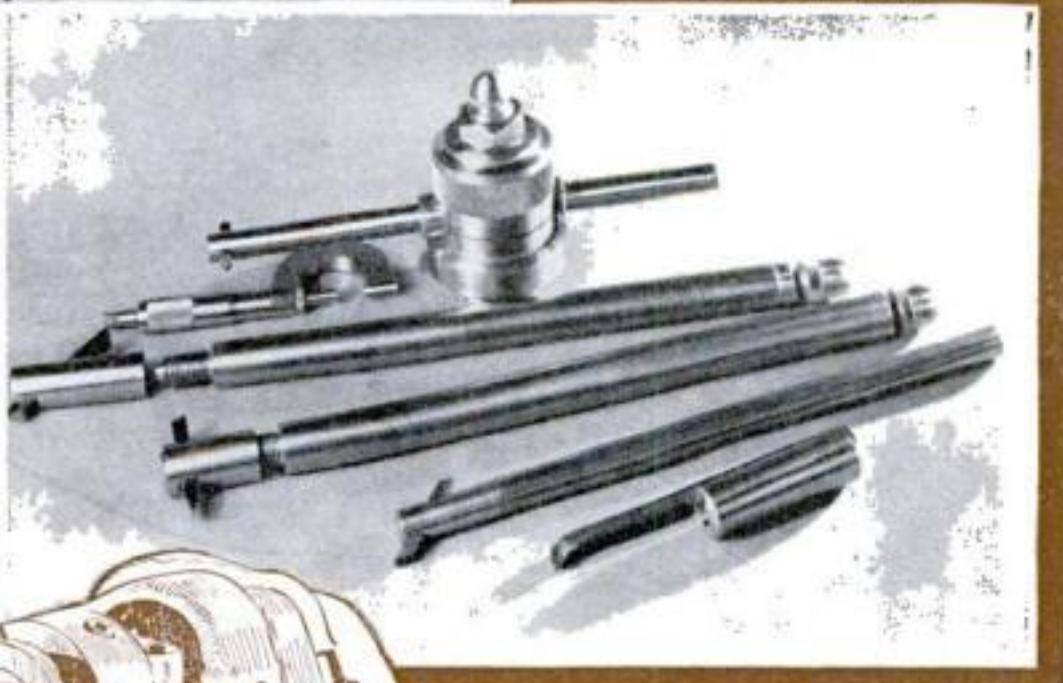
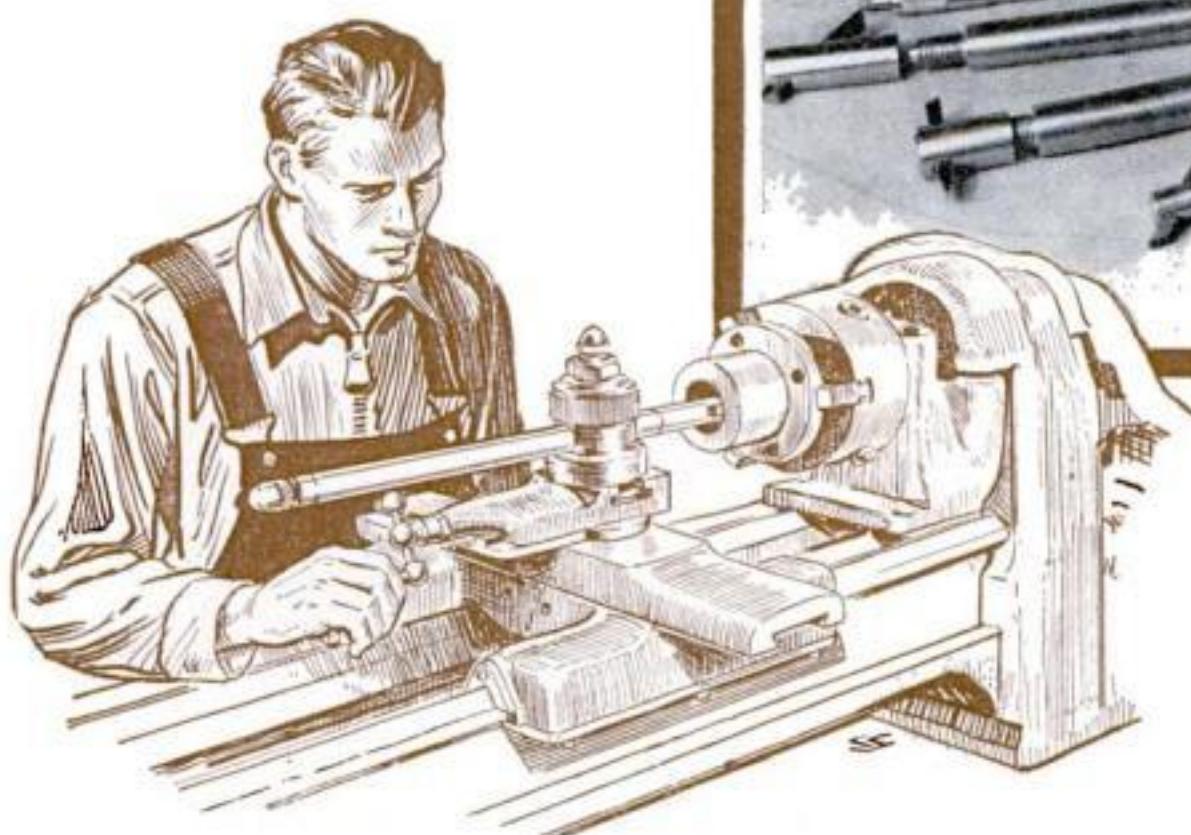


NEW SHOP IDEAS



Boring Bars AND Holders FOR YOUR LATHE

Holder with a $\frac{3}{4}$ " boring bar. The cutter is held in a 45-deg. end cap

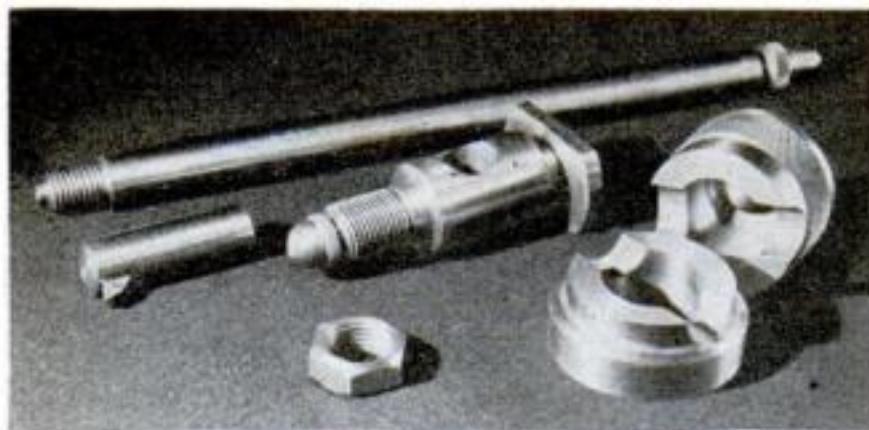


Reading down, holder with $\frac{1}{2}$ " boring bar, two $\frac{3}{4}$ " bars, a $\frac{1}{2}$ " bar, a $\frac{5}{16}$ " bar, and one of the split bushings

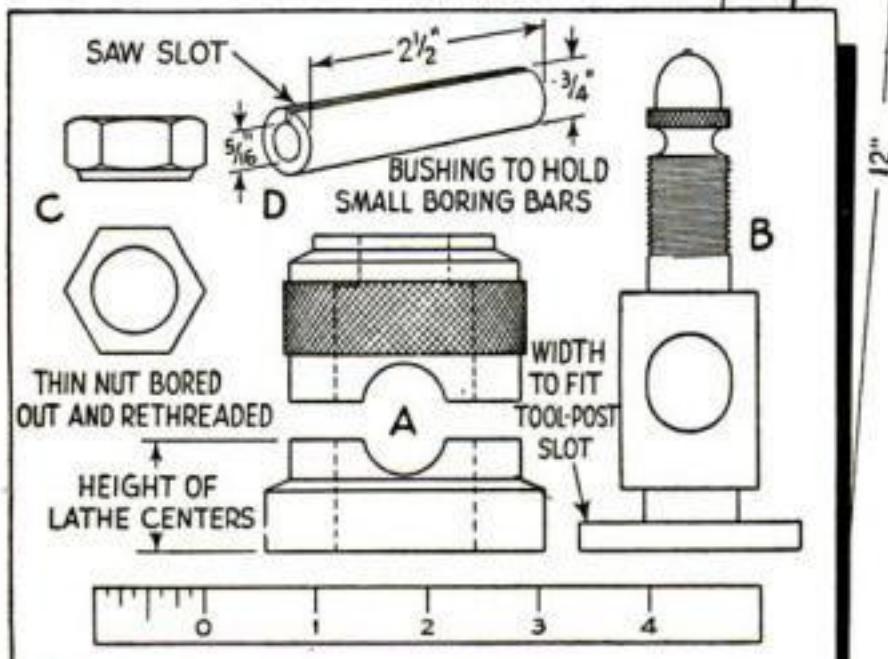
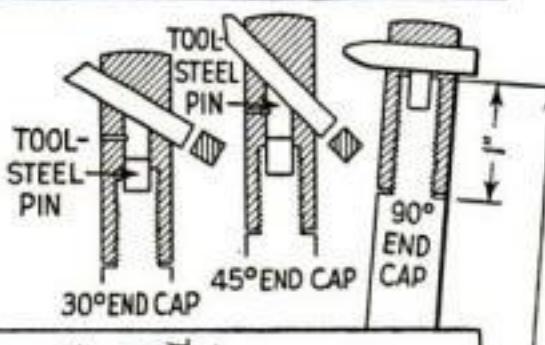
MUCH experience in tool making, not to speak of pleasure and real satisfaction, may be had by constructing lathe accessories such as the boring bars and holder illustrated. These were turned in the lathe on which they were to be used.

The larger bars and the holder are of cold-rolled steel; the smaller bars are of drill rod, and the end caps with the inserted cutters were purchased from a tool supply house. The holder itself was drilled for a $\frac{3}{4}$ " bar, and split bushings were made so that the smaller bars could be held.

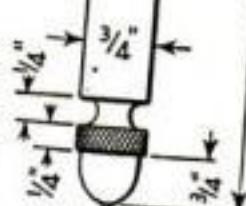
The outer shell of the holder was turned from two separate pieces as shown at A in the drawings. Dimensions, of course, will



Parts of the holder and a $\frac{3}{4}$ " bar with a 45-deg. end cap. At right are shown the three types of caps

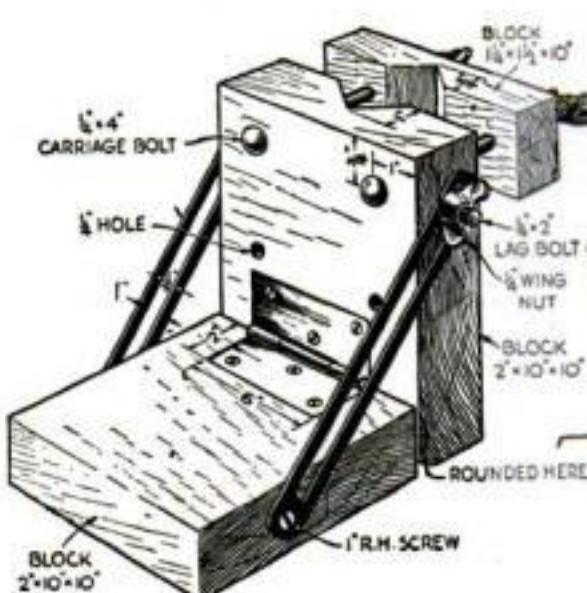


Shell and post of the holder as made for a 9" lathe. Dimensions can be modified to suit the lathe



Wooden Angle Vise Holds Parts to be Drilled

FOR holding wooden handles and other work to be drilled, an adjustable angle vise can be made as shown. It is also useful at other machines. The wooden parts are preferably made of a hardwood such as maple. Only one sliding clamp piece is shown, but two or more should be made. The shape of the V-slot in these pieces may vary to suit the work. The hinge should be at least 6" long, and 4" wide when opened. It is important to tighten the hinge so that there is no side play in it by lightly tapping it on top with a hammer.—JAMES B. LEETH.



vary to some extent, but the holder illustrated was made for a 9" lathe. The upper half was slipped on a mandrel and knurled. Later it was counterbored to fit the post shown at B. The post was turned from 2" stock, the bottom flange being the full diameter and $\frac{1}{4}$ " thick. This was later sawed on two sides to fit the tool-post slot.

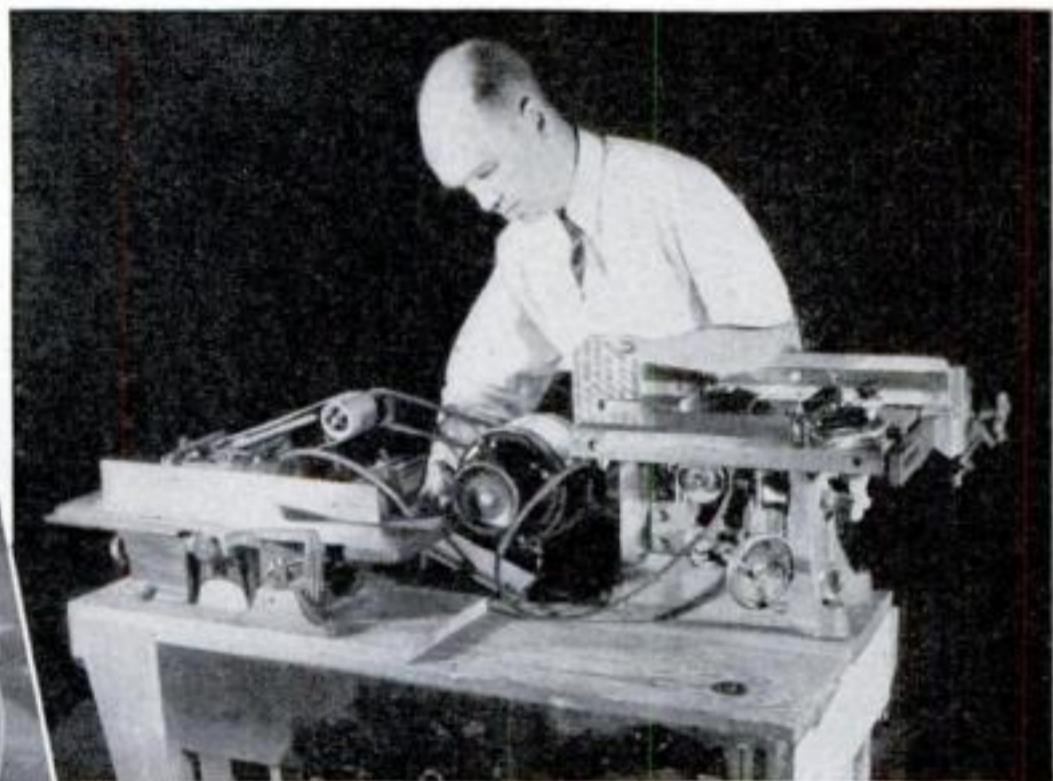
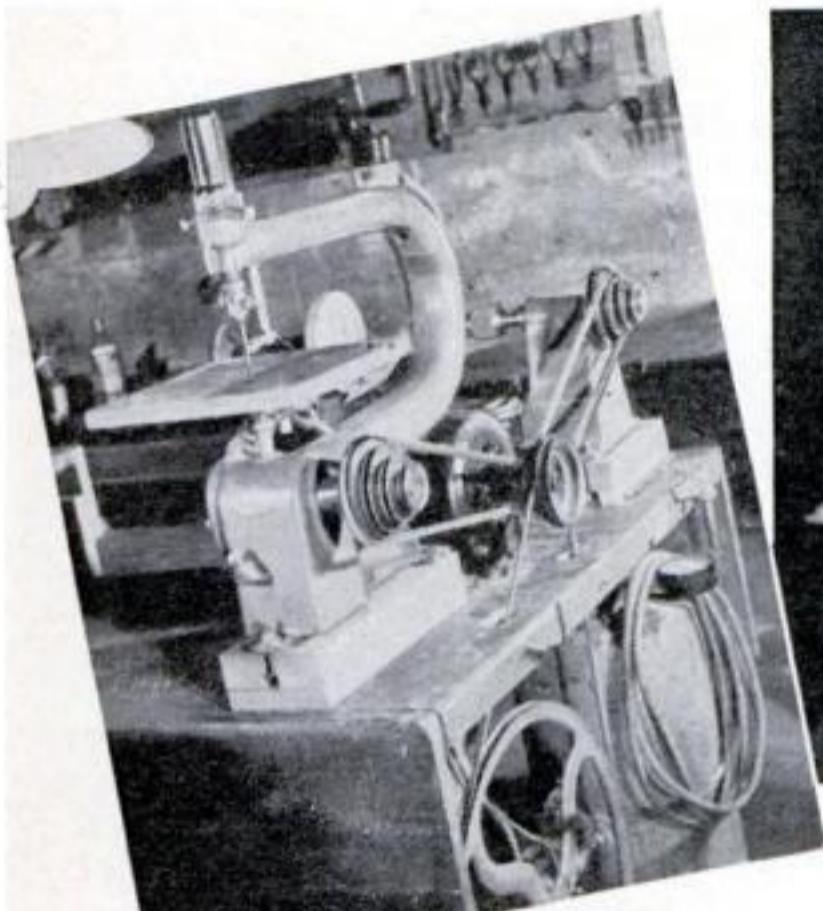
When the post had been turned and threaded, it was slipped into the holder shell and fastened in place on the lathe for drilling the boring-bar hole. A small, accurately ground drill was chucked in the headstock, and the holder was fed to the drill with the lathe carriage. The hole was drilled through both shell and post, then opened out to $\frac{3}{4}$ " in several easy stages. It was next necessary to elongate the hole in the post with a large round file.

The clamping nut C was made from a large heavy nut, which was cut in two and faced on top and bottom. Bushings were made as shown at D for holding the $\frac{1}{2}$ " and $\frac{5}{16}$ " bars.

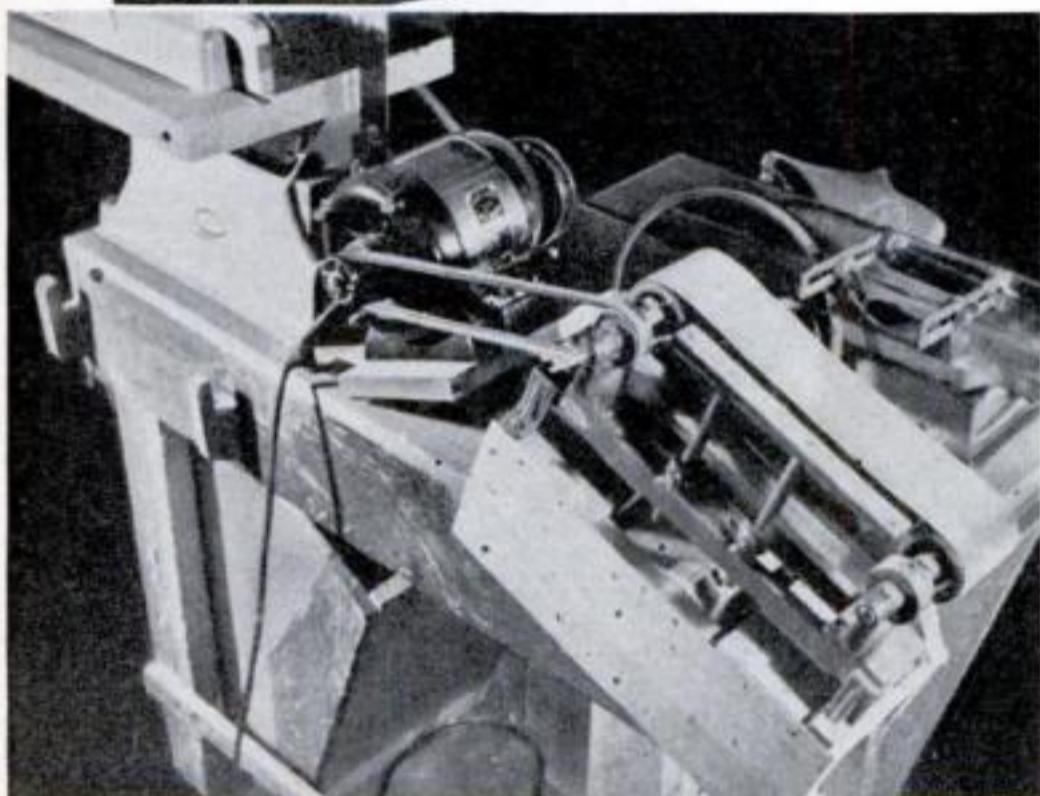
The boring bars were turned and threaded on one end to fit the purchased end caps. The acorns on the larger bars are purely an ornament. They take but a few minutes to turn and knurl, and add finish to the job. Standard dimensions for the bars are as follows: $\frac{1}{2}$ " in diameter, 8" long, and $\frac{9}{16}$ " in diameter, 9" long for $\frac{3}{16}$ " square cutters; $\frac{3}{4}$ " diameter, 11" long for $\frac{1}{4}$ " square cutters.—C. W. WOODSON.



Two Motors Operate Six Machines



At left, one motor drives a jig saw, lathe, and air compressor. The other views show a similar set-up



MOTOR-DRIVEN machines have considerably more power when belted directly to the motor than when run through a line shaft. One arrangement illustrated con-

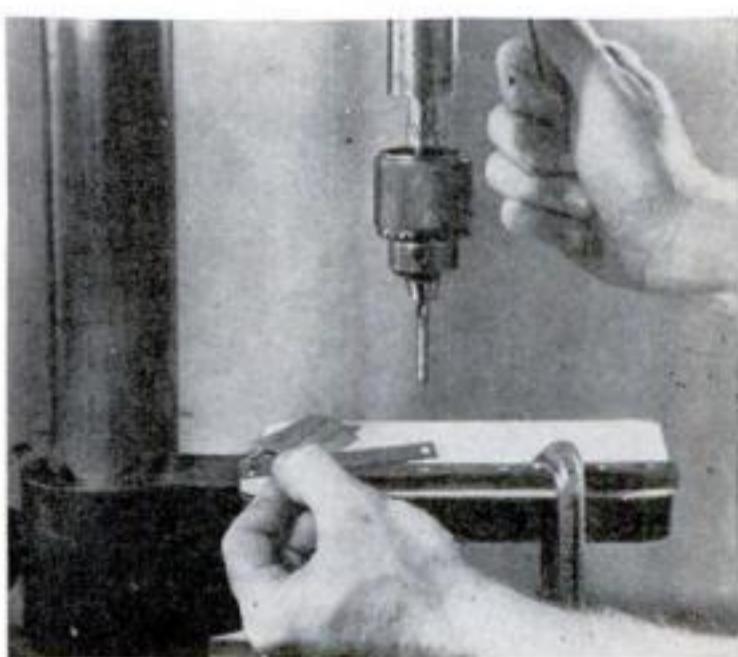
sists of a circular saw, jointer, and belt sander. These are driven by a double extension motor fastened to a base that is hinged at one end. The belt tension of the jointer and sander is governed by a wedge placed under the motor mounting. The sander is mounted on the bench at an angle so that it will support stock being ripped on the saw.

In the other layout a lathe, jig saw, and air compressor are driven from one pulley. There is an added advantage in that the compressor may be run simultaneously with either machine when it is desired to clean the bench with a blast of air. The motor may be

wired through the automatic shut-off of the compressor without affecting either of the other tools. The switch is mounted on the upper arm of the jig saw.—L. A. LEMBACH.

Using Drill to Punch Holes

DRILLING holes in very thin metal and other materials is tedious and unsatisfactory. For much work, however, a drill press will serve as a light-duty punch. A drill, to give the size hole desired, is run through a piece of flat, cold-rolled steel to form the die. The drill is then reversed in the chuck after the solid end has been ground flat to act as the punch. A C-clamp holds the die in alignment. The surfaces of both drill and steel may be honed flat to give sharp cutting edges, and in quantity work the die hole may be counter-bored from the back for slug clearance.—G. L.





Spring Center Guides Taps and Reamers

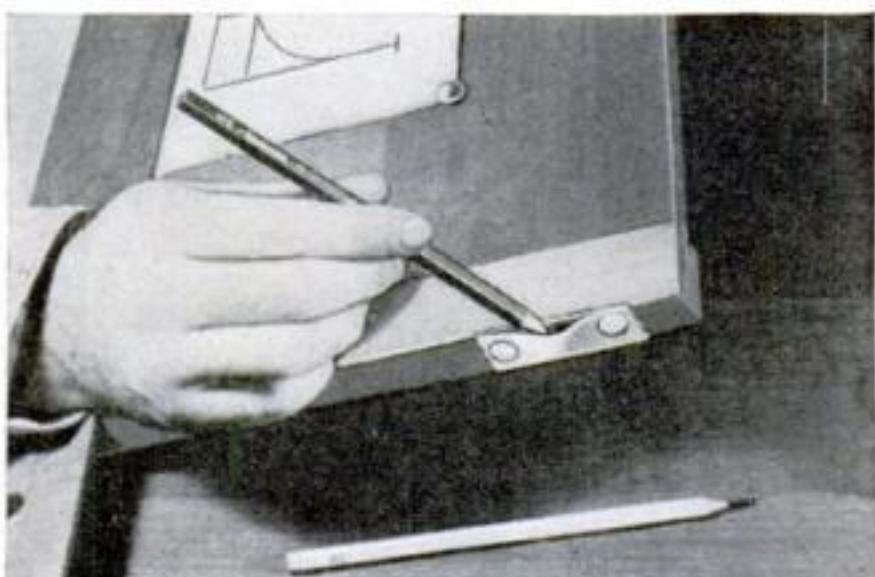
THIS spring center can be used in the lathe, milling machine, or drill press to start a hand tap or reamer absolutely straight. It is necessary only to drill the hole, remove the drill from the chuck, and insert the center in its place. The point on the center fits into the center hole in the tap or reamer and keeps a slight pressure on it while it is being turned with a small wrench. Delicate and expensive parts are often ruined by poorly tapped or reamed holes when a cheaply made tool such as this spring center would have saved them.—R. H. JOHNSON.

Small Droplight Illuminates Work in Close Quarters

FOR USE in close quarters, as when adjusting valves, it is desirable to have a small droplight or trouble lamp. One can be made from a socket with candelabra threads, a $7\frac{1}{2}$ -watt, 110-volt lamp to fit the socket, and a cord and plug. A wire guard can be bent for the lamp.—W. F. HOPKINS.

Drawing Pencils Pointed in Sandpaper Pocket

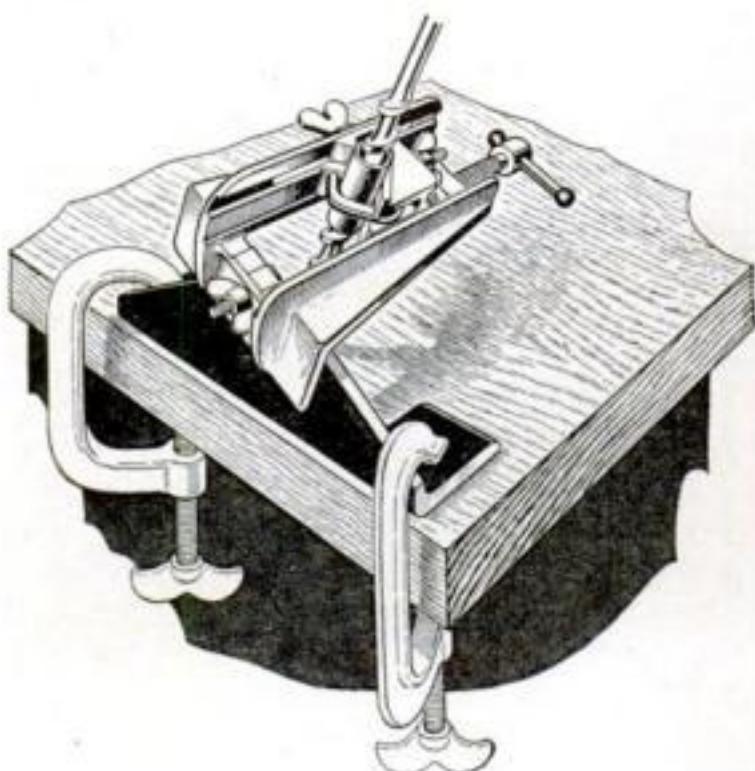
DRAFTING pencils can be sharply pointed without spreading graphite dust about by folding a small piece of sandpaper in half and tacking it to the edge of the drawing board. Insert the pencil point into the fold and spin it back and forth.—L. H.



The lead is sharpened dustlessly by spinning it in the folded sandpaper tacked to the board

Adjustable Jig for Boring Holes at Any Angle

HOLES may be bored accurately at an angle in wood by mounting a doweling jig of the type illustrated on a bracket cut from a piece of angle iron. Both the jig and the angle iron are drilled for a $\frac{1}{4}$ " bolt. The jig pivots on the bolt and is held at the required angle by a wing nut. The whole device is fastened to the work with clamps if possible; or the ends of the angle iron may be drilled for screws.

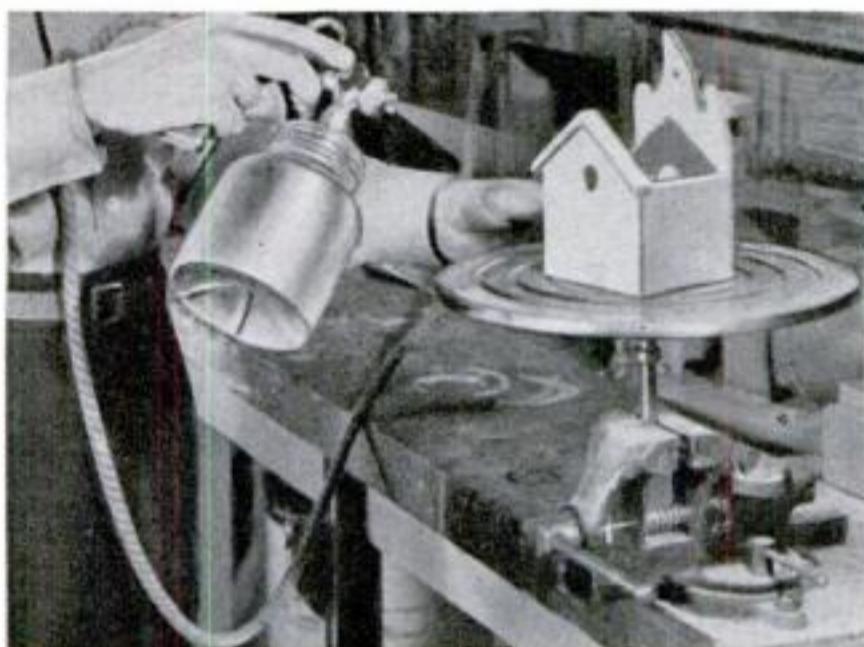
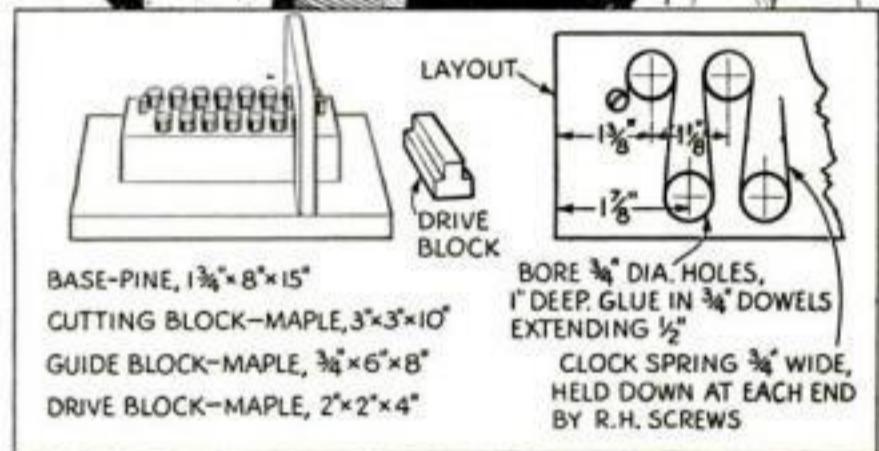


Sandpaper Belts Joined by Interlocking Ends

SANDPAPER belts can quickly be given a strong, perfectly smooth, interlocked joint by using a cutter made as shown. The blade, which is a $\frac{3}{4}$ " wide clock spring, is sharpened only enough to remove the blunt edge.

In use, one end of the new belt is placed over the cutter and severed by using the drive block and a mallet. A similar cut is then made at the other end.

For each joint, a piece of good muslin or lightweight linen is cut 3" wide and as long as the belt is wide. A coat of hot glue or waterproof casein glue is spread on the cloth, the fingers of the belt are interlocked, and the cloth is laid underneath. A piece of wax paper is placed above and below the joint, which is then clamped with a hand screw between two blocks of wood. Allow the glue to set for from six to eight hours before using the belt.—FRED H. SCHULTZ.



Phonograph Turntable Used for Paint Spraying

AN OLD phonograph turntable, which can often be obtained at practically no cost from a junk yard, is handy for holding small novelties that are to be spray painted. A small iron rod to fit the hole in the disk can be held in a bench vise as shown at the left to act as a bearing for the turntable. If much work of this kind is done, it pays to make a permanent base for the turntable and a shield so that the paint is not sprayed over the workbench.—F. H. MEYER.

Increasing the Capacity of a Drill Press

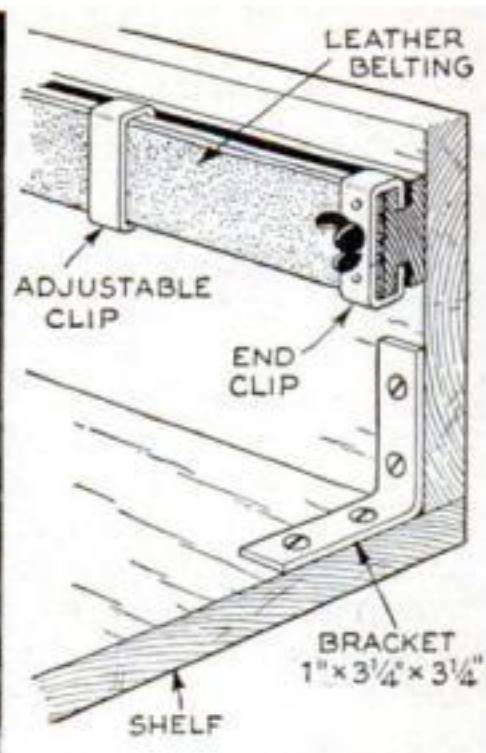
THE capacity of a small drill press may be increased by cutting off part of the column and welding an elbow between the column parts. In this instance the distance between the working bit and column was increased to 24". The base is bolted to a substantial frame or a wall; and a removable workbench, which can be fastened down solidly, is constructed to suit requirements.

—V. O. HANSEN.



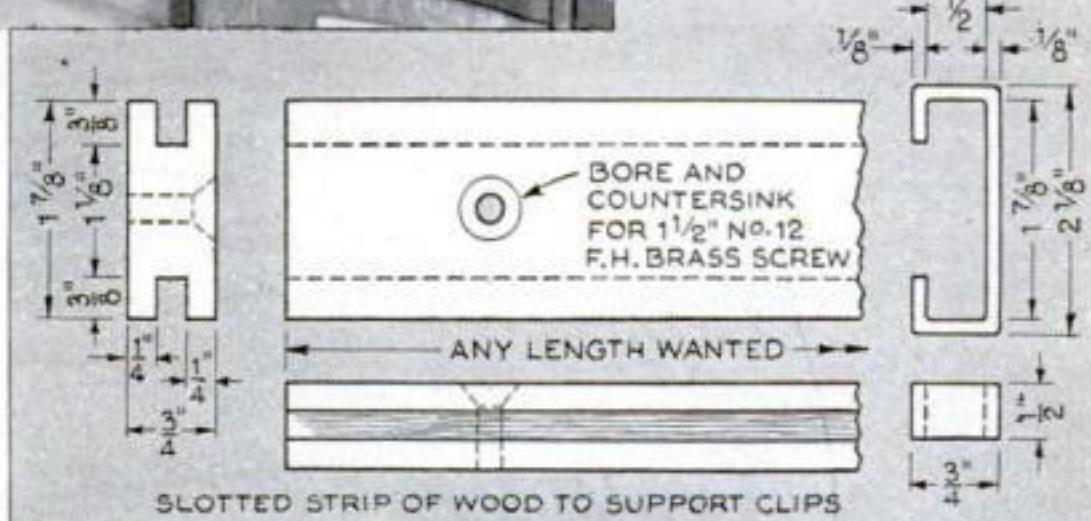
This arrangement is a practical one for a glass shop or sheet-metal shop

Leather Tool Rack Has Adjustable Divisions

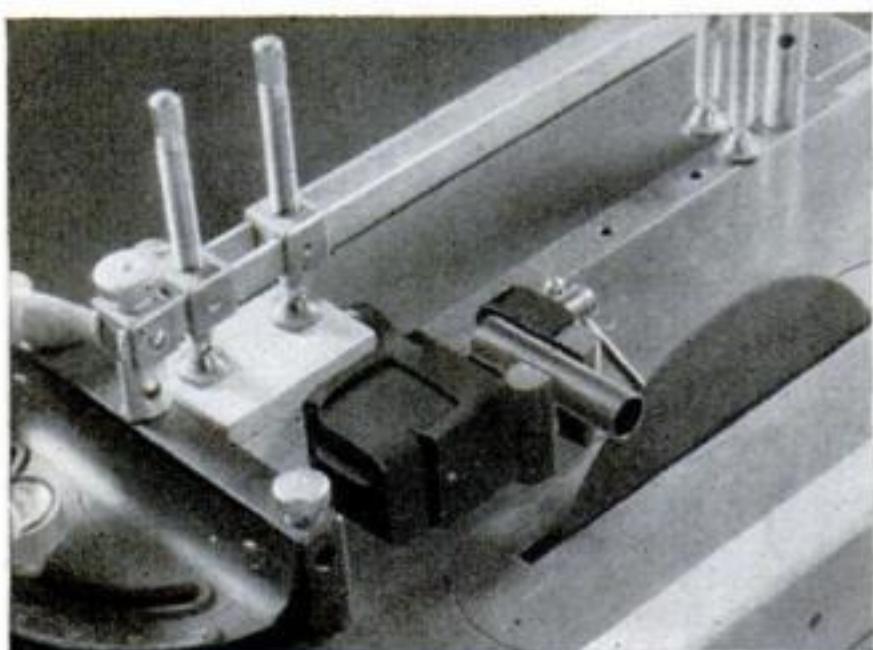


AN ADJUSTABLE tool rack may easily be made as shown from old pieces of leather belting and scrap pieces of band iron. It is suitable for the wall of the tool room as well as for an individual workbench. The one illustrated is located at the back of a wood-turning lathe bench.

The metal clips are bent to shape around a piece of $\frac{1}{2}$ " square cold-rolled steel $1\frac{3}{8}$ " long. Each end of the belting, which should be about $1\frac{3}{4}$ " wide and approximately $\frac{1}{8}$ " thick, is riveted to one of the clips. The two end clips might therefore well be made from band iron 1" wide. One of them is drilled and made fast at one end of the rack; the other is drilled and tapped for a wing bolt so that it may be secured after the tools are in place.—E. C. HANLEY.



The metal clips are bent to shape in a vise around a piece of cold-rolled steel



Small Vise Holds Metal for Abrasive Wheel

WHEN an abrasive cutting wheel is used in a circular saw, the regular miter gauge is usually employed to hold the metal being cut. A useful addition to this gauge is a small vise of the drill-press type for holding short lengths of material. It is clamped to a wooden block, which is, in turn, clamped in the miter-gauge hold-down clamp. The surface speed of dry cut-off wheels should be about 7,500 feet per minute.

Smiling Dan THE HIGH-DIVING MAN

CAN you manipulate Diving Dan so that he will hit directly in the center of the tub when he does his spectacular high dive? There is fun for youngsters and amusement even for oldsters in this novel toy, which requires skill to operate with the greatest degree of success.

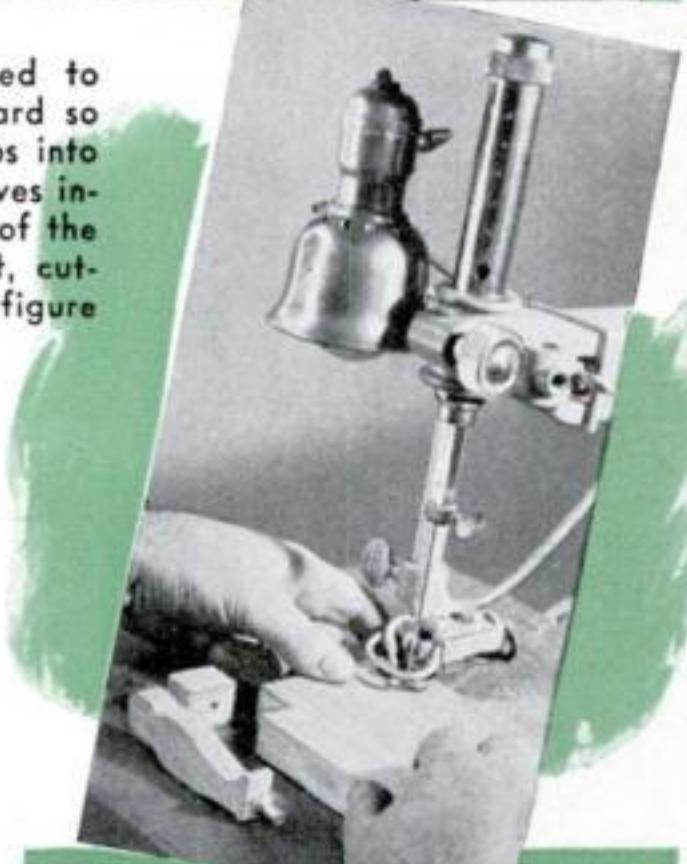
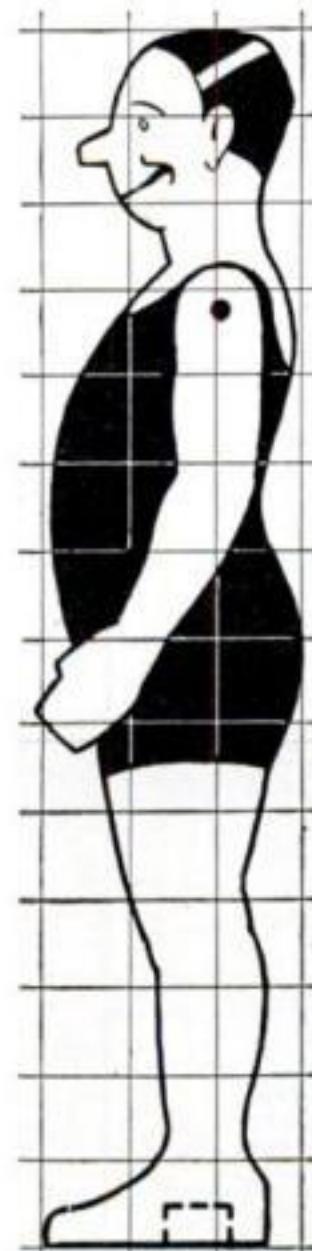
The toy is a miniature of the sensational aquatic feat occasionally seen at fairs and carnivals. The base and upright may be put together from almost any wood. Their only purpose is to support a diving board 20" or more above a deep metal dish filled with water. Both the base and uprights were in this instance cut from pine, two corners of the base being notched so that the bottoms of the uprights could be attached neatly and securely with two screws.

In making the diving board, it is best to cut a piece of wood down roughly to about $\frac{1}{8}$ " thick, then plane and sand it thinner until it has the required springiness. Round off the free end, and quite close to the end fasten a very short piece of small dowel with waterproof cement. This is to fit loosely in a hole drilled in the feet of the diving figure.

After cutting the figure from wood about $\frac{1}{2}$ " thick, give it a good coat of well-thinned enamel. When this is dry, the figure may be decorated with flesh, red, and black enamels. The swinging arms are cut from heavy tin or light steel, as they must have enough weight to control the direction of the figure when the diving board is depressed with a finger and then suddenly released to throw the small diver into the air.—BERNARD BONVOULOIR.



Skill is required to spring the board so that Dan jumps into the air and dives into the center of the pool. At right, cutting out the figure

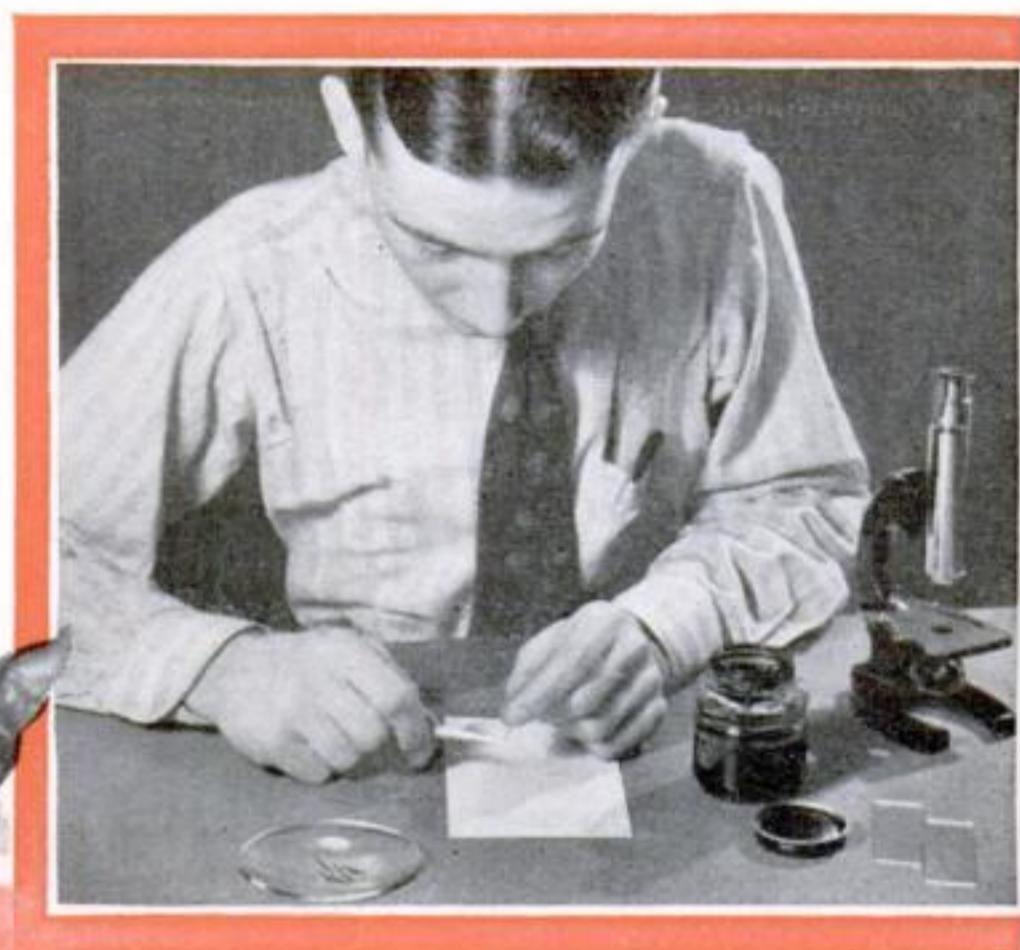


Hair Tells a Story Under

Interesting specimens of hair are obtained from household pets. At right, inking a hair to make the surface markings visible



To wash off grease, swish the specimen through a cleaning solution. Right, making a collodion cast of a hair. At far right, using a razor blade to make longitudinal sections



HAIR is one of the world's most important possessions. Besides covering up odd bumps on human heads, providing animals with warm coats, and making debutantes and chorus girls more alluring, it is the basis for such useful things as felt, upholstering materials, and woolen cloth. Such a highly useful material ought to be a fertile subject for microscopic exploration.

You will be able to obtain an abundance of hair specimens from three different sources. First, your own head, unless you are as bald as a billiard ball; and in that case you can try your eyebrows or your arm. Second, the



Your Microscope

By MORTON
C. WALLING

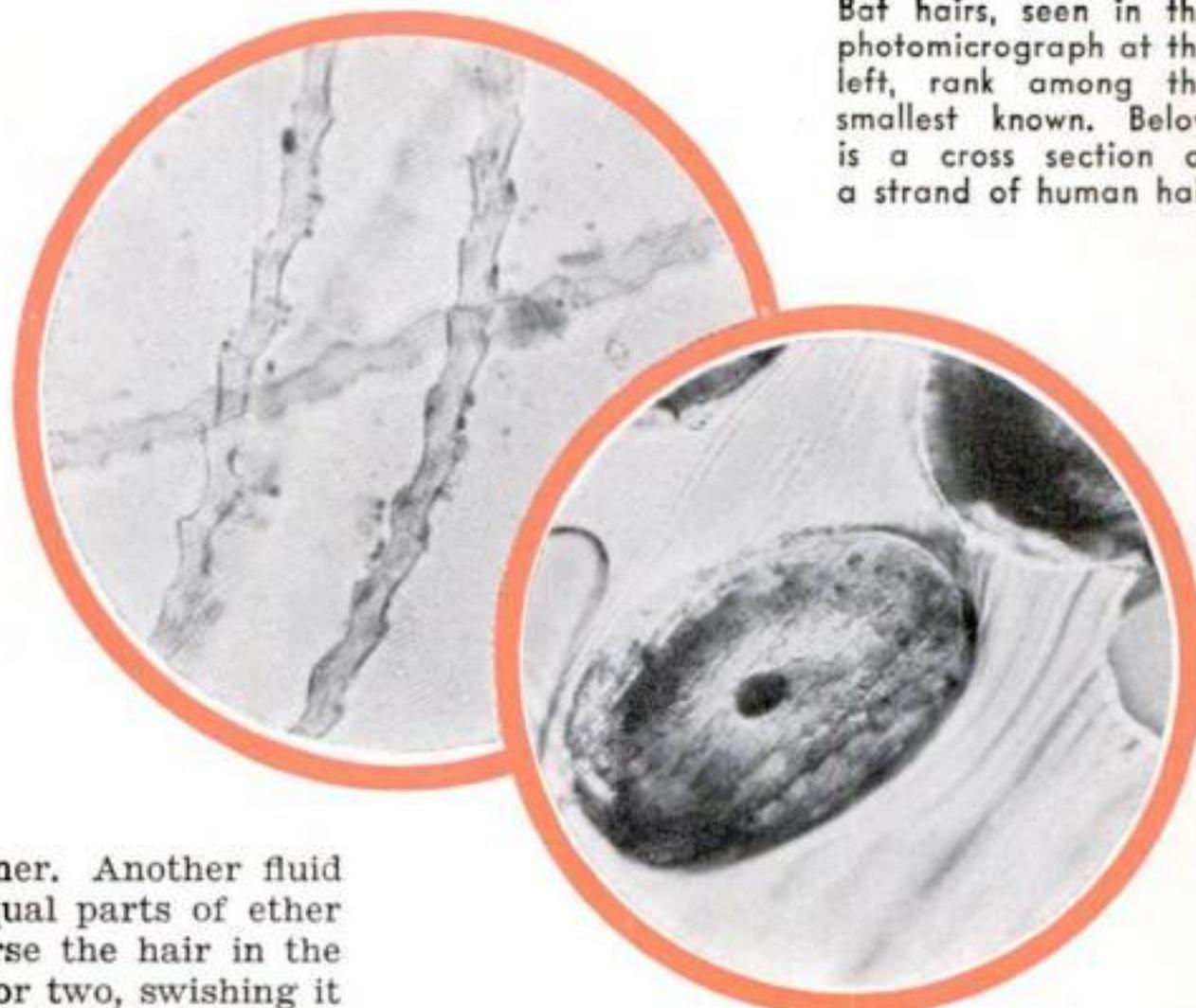
household dog or cat, or the mouse you caught in the trap this morning. The third source is the clothes closet, where you will find such materials as woolen cloth, fur neck pieces, and sheepskin lining in jackets.

All hair is oily or greasy when first taken from the animal, and in order to make the most of your observations you must remove the grease and, incidentally, the dirt that is held by it. Any good solvent will do this. Carbon tetrachloride is suitable. So is lacquer thinner. Another fluid often used consists of equal parts of ether and 95% alcohol. Immerse the hair in the solvent for a minute or two, swishing it around a bit, and then dry it with lintless cloth or between blotters; or simply let it dry in the air.

Examine first the surface of the hair. At a magnification of 400 diameters or so, you will be able to see that the surface is marked by numerous wavy lines, running around the hair and roughly parallel to each other. Focus sharply on a plane through the middle of the hair, and you will see that the edges are slightly saw-toothed, with the points of the "teeth" pointing away from the base of the hair.

The wavy lines are the edges of very thin

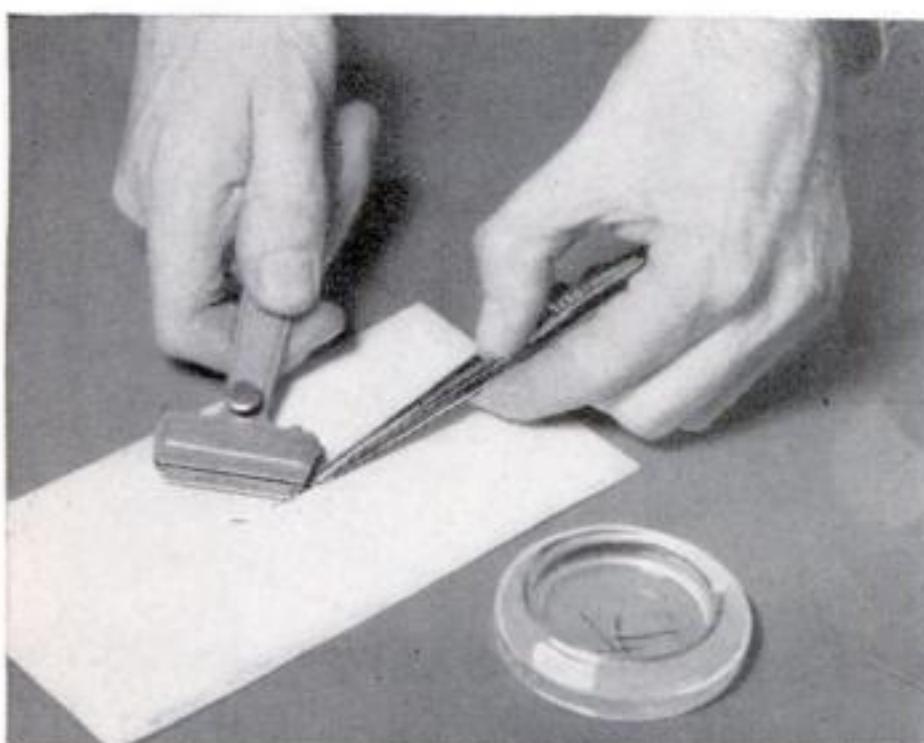
Bat hairs, seen in the photomicrograph at the left, rank among the smallest known. Below is a cross section of a strand of human hair

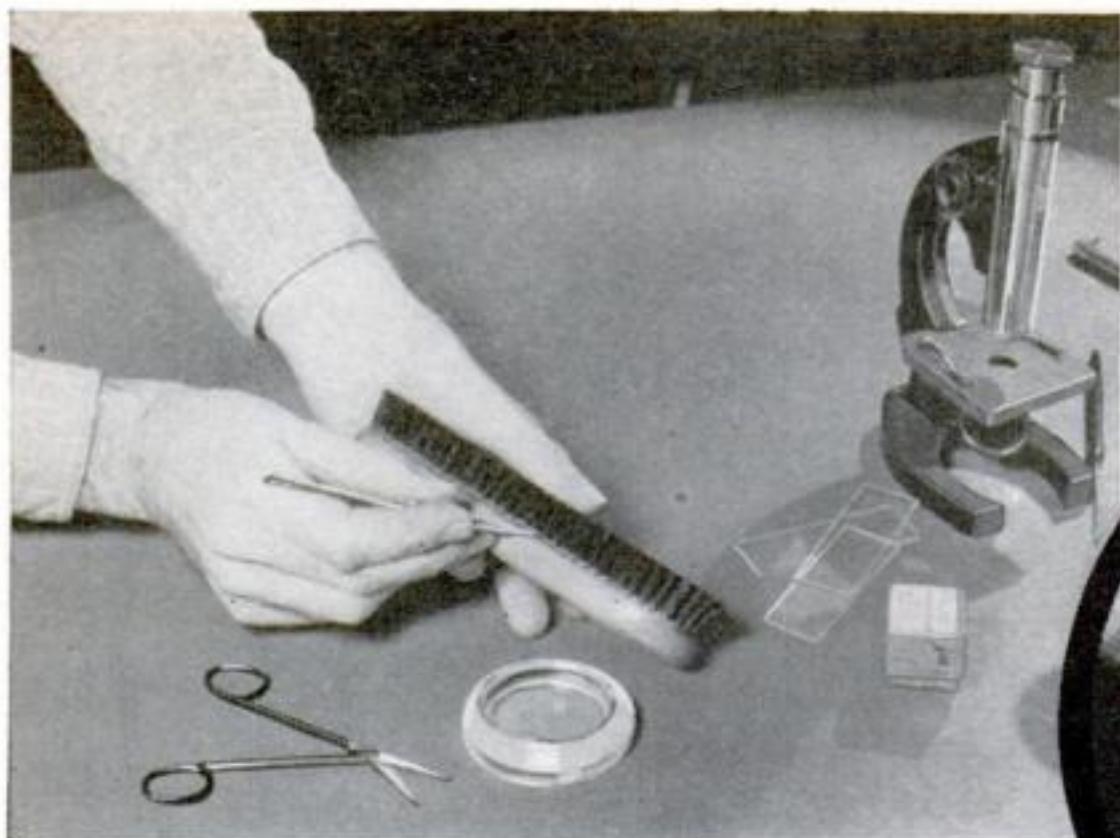


plates that overlap each other like shingles, their exposed ends pointing toward the outer tip of the hair. This layer of plates is called the cuticle. In many animal hairs it is composed of scales rather than the more continuous plates.

By racking your focus carefully up or down, you can see sharply first the top surface of the hair, then the middle and edges, and finally the lower surface, since most hairs are quite transparent. When focused on the middle plane, you can see the medulla plainly. This is a region in the center of the hair forming a core, and composed mostly of dry, wrinkled material and air bubbles or pockets. The air appears dark or black by transmitted light. The region between the medulla and the cuticle is the cortex, and it is composed of many long, threadlike cells pressed tightly together much like the wires inside a telephone cable. These cells are among the smallest units of animal tissue known. In hairs that are colored, specks of pigment are scattered among the cortex cells.

For seeing the surface imbrications, or lines, viewing the hair by polarized light will help. A simpler way is to dip the hair in blue or black ink, and then wipe it gently with your fingers.



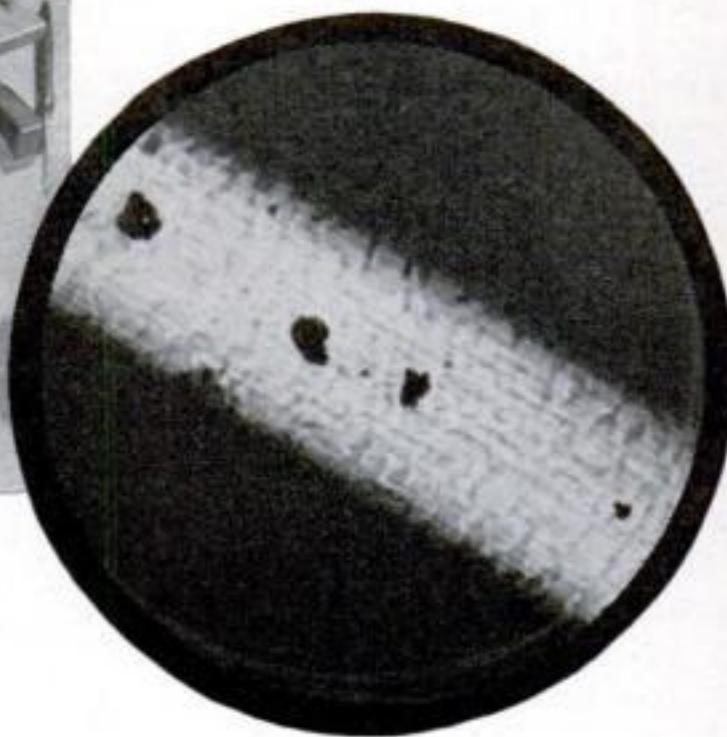
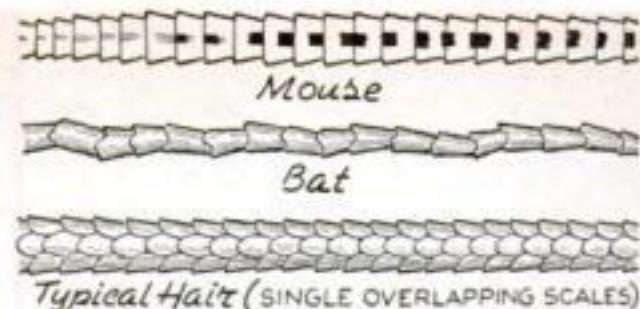


A clothes brush yields a specimen for microscope study. At right is a blond human hair, showing overlapping scales and medulla. Drawings illustrate three different types of hair

The ink will lodge in the tiny grooves formed by the edges of the plates and the layer beneath them, and make the markings easier to see.

Hairs can be mounted either dry, in balsam, or in one of the special mediums mentioned, for permanent preservation. In a dry state, their surface markings may show plainer than in balsam. It's a good idea to try all types of mounting.

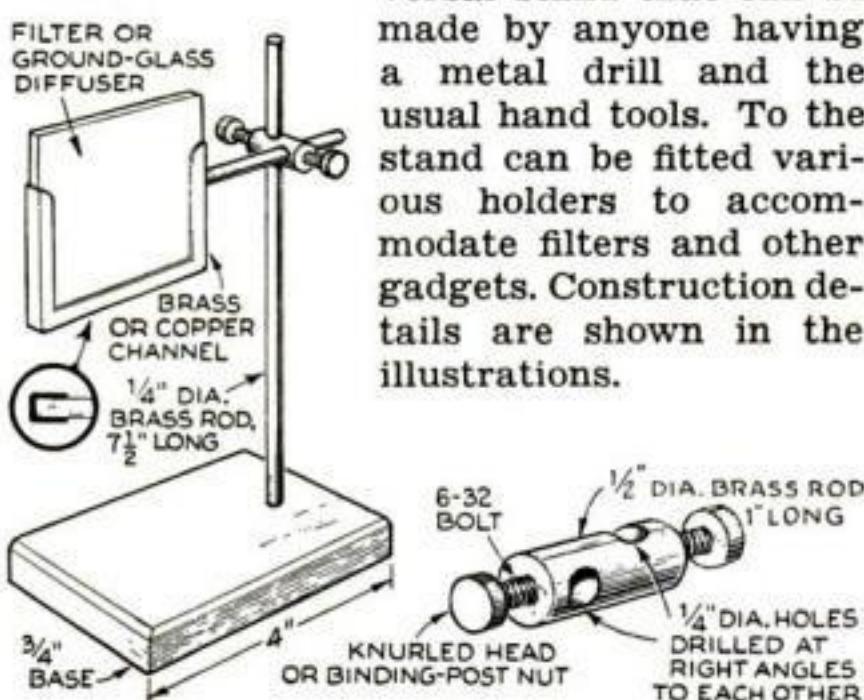
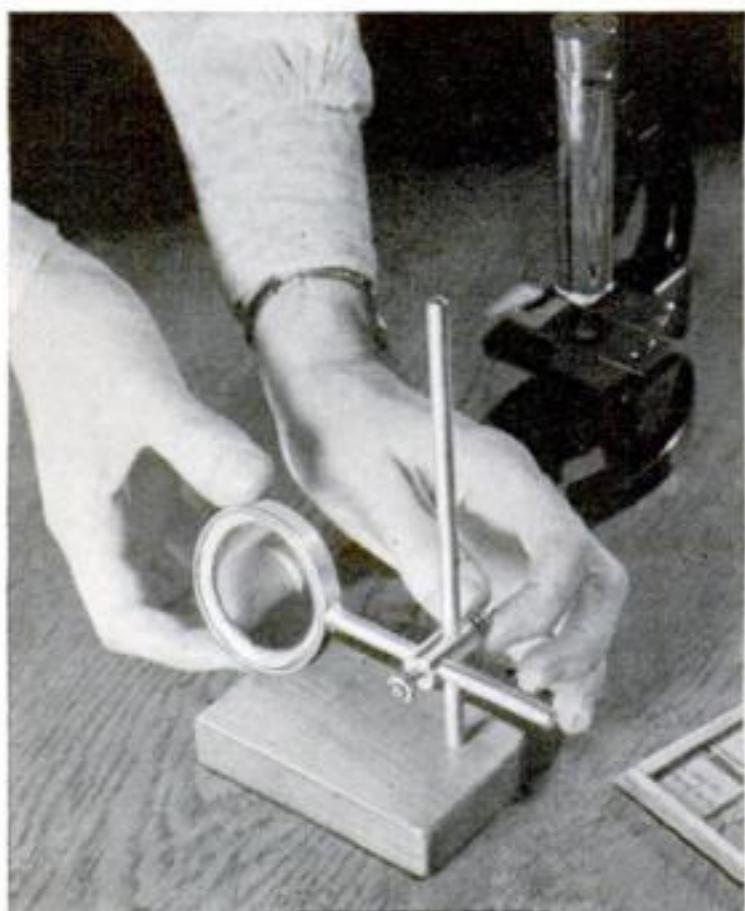
Examine next a hair from a sheep. You don't have to go to a pasture or ranch to



get it, but only to the nearest woolen sweater or other garment. Observe that the surface imbrications are much more pronounced than in a human hair, that they are coarser and their edges protrude more. This roughness of wool is a highly important matter, for it makes possible the useful "felting" action.

When lamb's wool, rabbit fur, or other similar hair is (*Continued on page 238*)

Universal Stand for Accessories



THE problem of holding filters, diffusing screens, and auxiliary condensing lenses in the path of light traveling to a microscope mirror can be simplified by a universal stand that can be made by anyone having a metal drill and the usual hand tools. To the stand can be fitted various holders to accommodate filters and other gadgets. Construction details are shown in the illustrations.

Tricks with Fire FOR HOME CHEMISTS



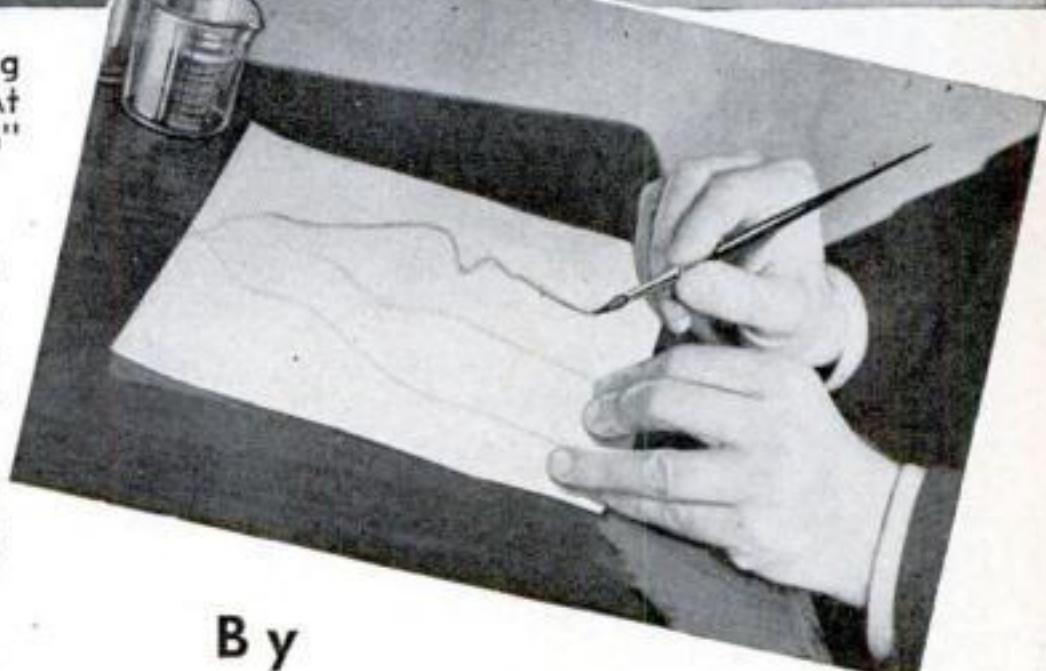
Glowing spots of fire race along winding trails in this thrilling chemical game. At right, preparing the paper "race course"

WHAT is combustion? That looks like an easy one—isn't it what happens when something burns in the air, or in oxygen gas? But wait a minute: Here is a big dictionary that defines combustion as *any* chemical process accompanied by the evolution of heat and light.

Now, perhaps you have tried the experiment of lowering a lighted wax taper or a jet of burning hydrogen into a bottle of chlorine gas, and recall that the flame continues to burn. In this peculiar sort of combustion, no oxygen is needed at all. Likewise other chemicals that combine with showy displays of light and heat, including sulphur and some metals, provide out-of-the-ordinary kinds of combustion to experiment with in your home laboratory.

Place in a test tube a mixture of iron filings and sulphur, using about twice as much sulphur as iron by volume. Heat the test tube from the bottom with a Bunsen flame. (An alcohol flame will not give sufficient heat.)

Soon the contents of the tube will begin to



By
RAYMOND B. WAILES

glow. Now you can remove the tube from the flame. Unabated, the glow spreads through the mass. Its source is the heat liberated by the chemical union of the iron and sulphur. After the reaction has subsided and the tube has cooled, break it open and examine the contents. The residue consists of iron sulphide, which you can use in future experiments calling for this chemical.

Copper reacts with sulphur in much the same way. Insert a roll of copper wire or screen in a test tube, and then half fill the tube with powdered sulphur. Heat the tube as before. In this case, also, a glow will appear, but will continue only as long as the



Combustion without oxygen: a mixture of iron filings and sulphur, heated in a test tube, glows brightly as the iron and sulphur unite

tube is held in the flame.

To vary this experiment, a pinch of sulphur may be placed on a sheet of copper and heated over a Bunsen flame. The sulphur will burn and combine with the copper, forming a black spot of copper sulphide. That this discolored area differs from the surrounding copper can be proved by its brittleness. You can poke a match stick through it.

Fireworks occur when sulphur combines with zinc dust or with magnesium powder. Do not use a test tube in this experiment, for the mixture burns like gunpowder and might be expelled with considerable force. Instead, ignite a small pinch of the mixture, unconfined, with a red-hot iron rod or a long, burning splinter. Zinc sulphide or magnesium sulphide is formed, depending on the metal used.

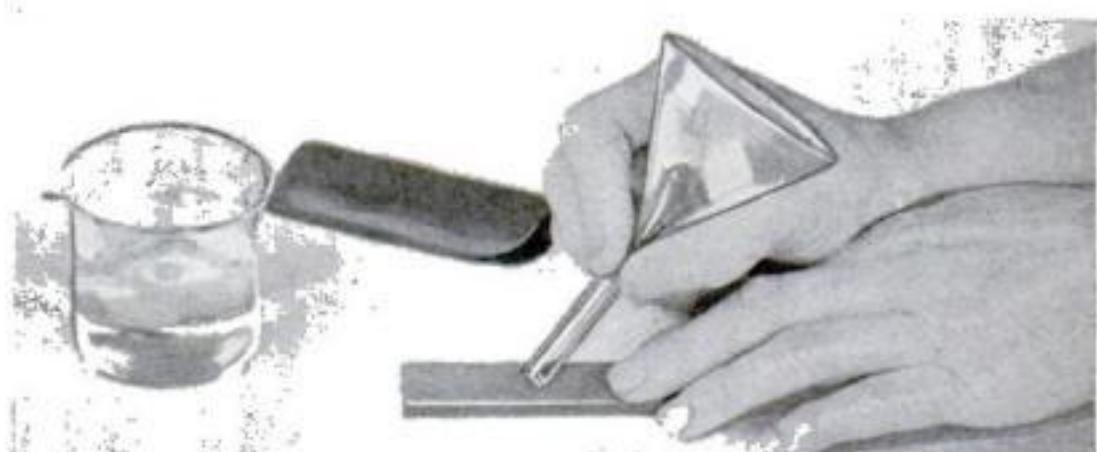
In contrast, the reaction of other metals with sulphur may take place mildly. A drop of mercury, rubbed with sulphur, yields black sulphide of mercury.

Lead sulphide, or artificial galena, and aluminum sulphide may be made by heating the metallic shavings with twice their volume of sulphur. This should be done in a covered crucible of clay.

How To Repair a Broken Funnel Stem

IF YOU break the stem of a funnel, you can easily provide a new bevel edge by grinding down the sharp broken end. Carborundum stone of coarse grade may be used as the abrasive, with water for lubricating and cooling. Usual practice is to make the bevel about sixty degrees, as shown. Drops of liquid

will flow more easily from such a beveled end than from a square-cut, circular opening, which is the reason why most laboratory funnels are made this way.



or porcelain, to keep the mass from oxidizing in the air. Aluminum sulphide, a grayish crumblike residue, must be kept in a tightly stoppered bottle; it is decomposed by water or even by the moisture in the air, releasing malodorous hydrogen sulphide gas.

When oxygen takes part in combustion, chemicals containing it often serve as a better source than the air. Such a compound is potassium nitrate, which also goes by the names of saltpeter and niter, and which you can apply in an entertaining way.

A "fiery race course," an amusing little game concocted with the aid of this chemical, consists of a treated sheet of paper to which a lighted match or cigarette tip is applied at a point marked "Start." Two or more glowing trails of fire appear, advancing across the paper until they reach a goal marked "Finish." Owing to chance or to different lengths of their courses, one fire trail will arrive at the finish before the others and the player who has chosen it is the winner.

To prepare the paper, dissolve a pinch or so of potassium nitrate in about a teaspoonful of water. Using this solution as an ink, trace the courses from start to finish, in wavy lines of differing length. Then let the paper dry. If it is not too glossy, the marking will be almost invisible, and will convert the courses into fuse or touch paper. Visible numbers may be inserted in ordinary ink near the start, so that the players can choose their "horses" or positions. Or for

added suspense, players may select numbers at random, and the numerals may suddenly show up as convolutions in the fire trails. An old metal pan may be used to hold the paper while it is burning, and keep the charred scraps from scattering.

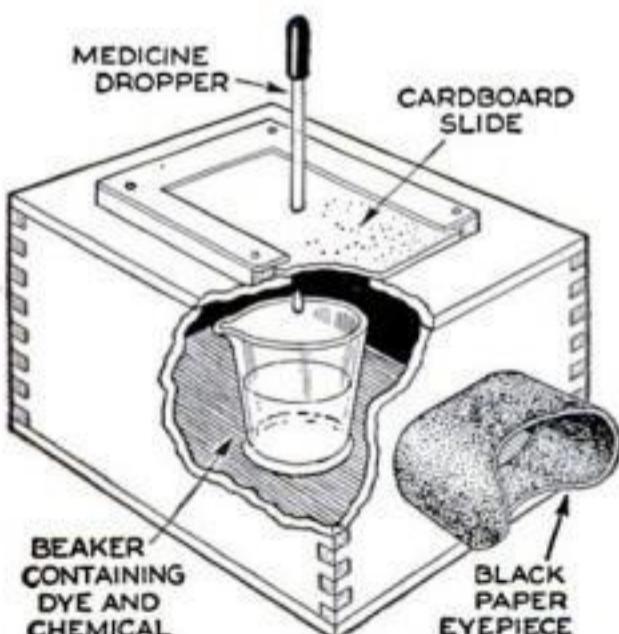
DYES of various kinds undergo a reaction akin to combustion, giving out faint light in the process, when treated with oxygen-containing chemicals. When the experiment is performed in the dark, the glow becomes visible. Ordinary powdered dyes sold for household use may be tried out in this test, and also the dyes known as eosin, anthracene, alizarin, methylene blue, and gentian violet.

Simply mix a pinch or so of the dye with some powdered ferrous sulphate or ferrous ammonium sulphate, in a beaker, and take the mixture into a room that can be made absolutely dark. When this has been done, add a few drops of hydrogen peroxide of ordinary drugstore strength (three percent). At this moment, (*Continued on page 299*)



CHEMILUMINESCENCE

By using the light-tight box illustrated below, you can observe a reaction akin to combustion, when certain dyes are treated with chemicals containing oxygen





Ideas for Radio Interference Located with Handy Portable Outfit

As the tester's antenna is pointed in various directions, an increase in volume indicates the source

AS A valuable aid in locating "man-made" radio interference caused by electric refrigerators, switches, fans, and the like, the outfit shown at the left has been designed. It is actually a supersensitive portable receiver with a built-in, highly directional loop antenna, as well as one of the fish-pole type. A loudspeaker gives audible checking of interference noises, while an output meter near the handle gives visual indication of the reduction of interference resulting from the use of filters and similar corrective measures applied to the noise source. It contains its own batteries.

Kit Aids Electric-Phonograph Builders



Parts for making an electric phonograph. It may be hooked up to your radio

RADIO fans who enjoy making their own cabinets will find the phonograph-amplifier kit illustrated just the thing for building an electric phonograph or for converting their present receiver into a radio-phonograph combination. The kit includes an electric turn-table, crystal-type pick-up arm, audio-amplifier circuit, and a large-size loudspeaker capable of handling a heavy output. The completed unit can be used separately or in connection with any modern radio receiver. Convenient panel mountings make the record player and speaker easy to install.

Radio Set Builders



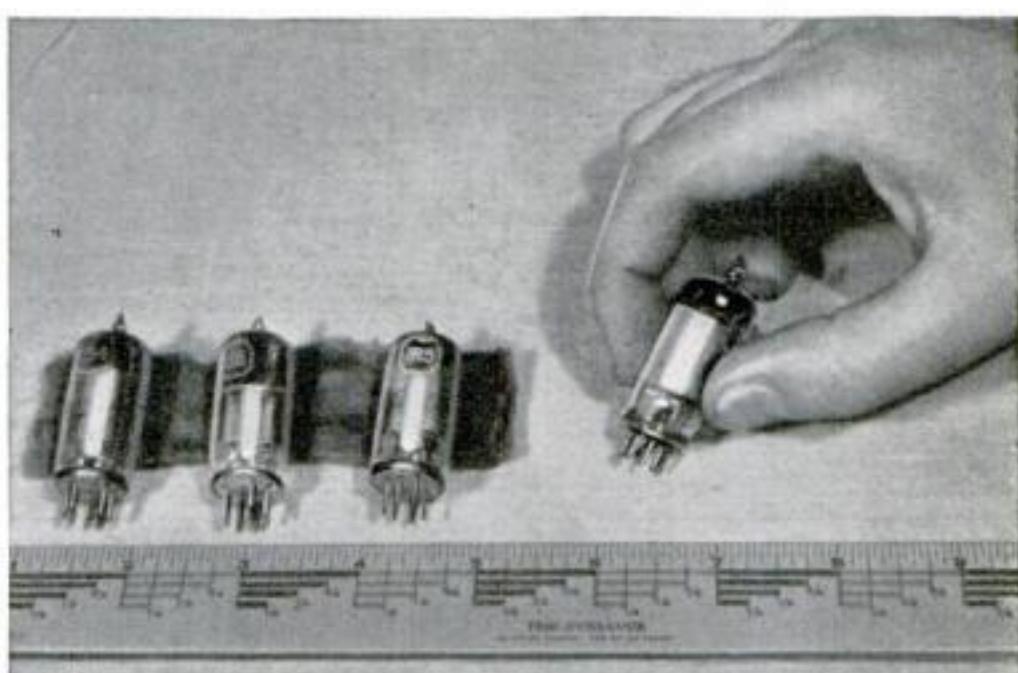
Adjustment of push-button radio tuning is easy with this unit

Novel Aligner for Push-Button Radios

PUSH-BUTTON radio controls are easily put into alignment so that they tune in stations accurately, with the aid of the device at the left. Contained in a small box with eight buttons on the top, the unit is a midget oscillator which transmits on frequencies identical with those of the desired broadcasting stations. Pressing one of the buttons and listening to the tone of a receiver's speaker permits speedy aligning to any wave length. The aligner plugs into an electric outlet.

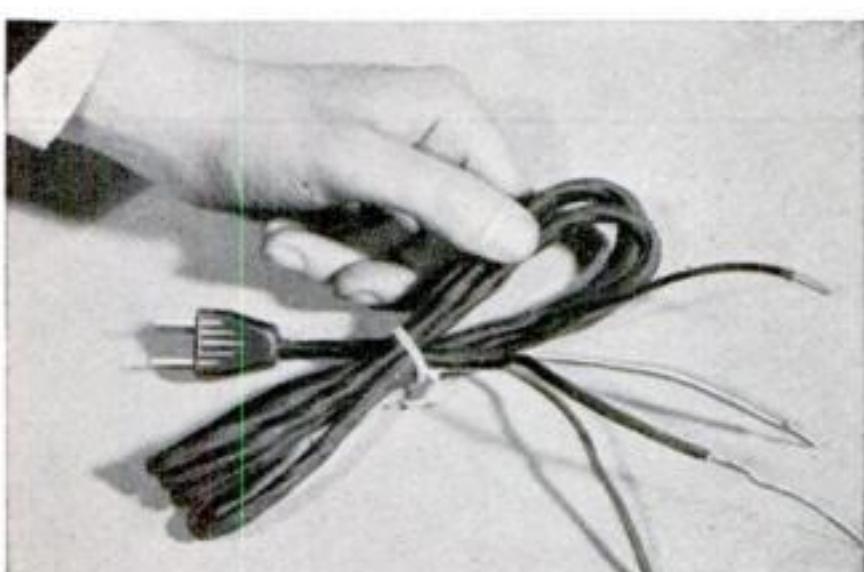
New Midget Tubes for Battery Sets

AMATEUR set builders will find many uses for the four new miniature battery-type vacuum tubes illustrated at the right. Particularly suited to use in portable sets, the tubes are of glass construction, without bases, and measure only $\frac{3}{4}$ " in diameter and $2\frac{1}{8}$ " high, including their wire-type prong connections. Occupying only one fifth of the space required by tubes of conventional size and design, the new units provide for all connections through base prongs and have no cap connectors. Designed to operate directly on a $1\frac{1}{2}$ -volt "A" battery, they are said to give high efficiency with a single 45-volt "B" battery. The stem of the tubes



Compare the size of the tubes with foot rule in foreground

is similar to the "button stem" which has been used in metal tubes for some years. The seven prongs of the small tubes are arranged in a circle.



Two extra leads provide for pilot-lamp connections

Power Cord Has Tap for Pilot Light

A NEW type of power cord with built-in resistors, just marketed for use in A.C.-D.C. sets having pilot lamps, delivers the required filament voltages for the pilot lamp as well as the vacuum tubes, thus eliminating the necessity of including a special resistor in the pilot circuit. Two resistance wires providing two different voltages are contained in the single cable, as shown in the photograph at the left.

By
ARTHUR C.
MILLER



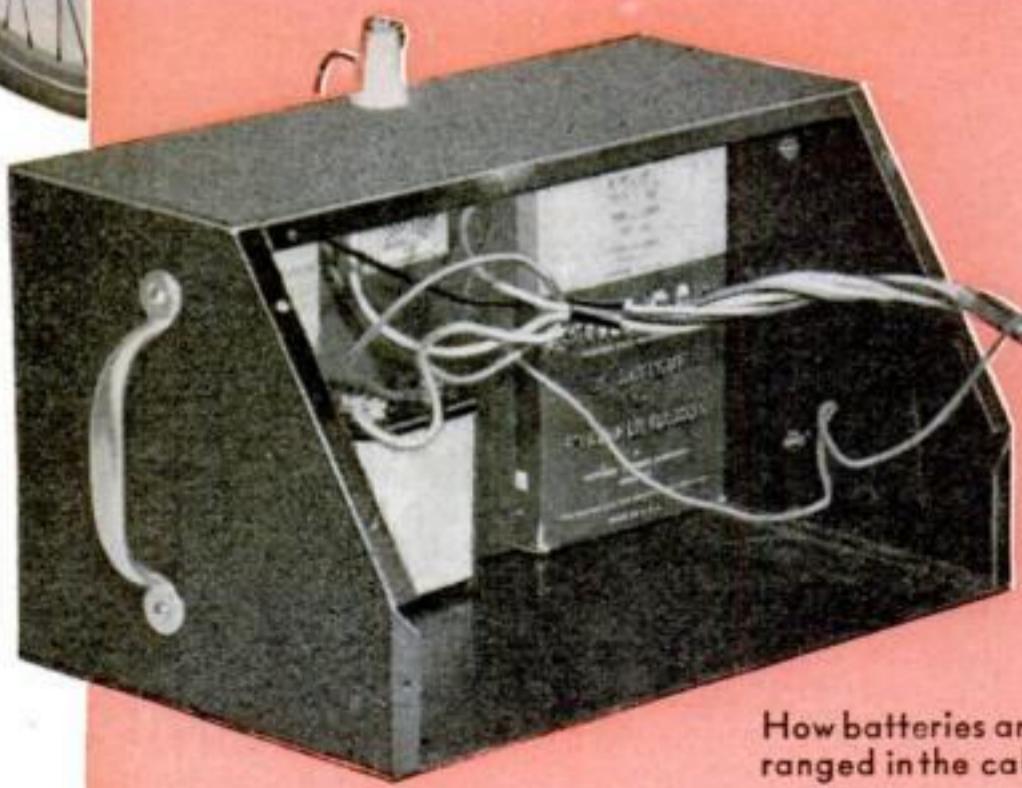
Bicycle

FANS who would like to install a radio on their bicycles so they can enjoy their favorite programs while riding around town or on short trips will find the inexpensive set described on these pages just what they have been looking for. Fitting in a basket mounted on the handlebars, the battery-operated, four-tube receiver contains its own loudspeaker. It gives excellent results on local broadcast stations, and if iron-core coils instead of the air-space type specified are used this range will be increased.

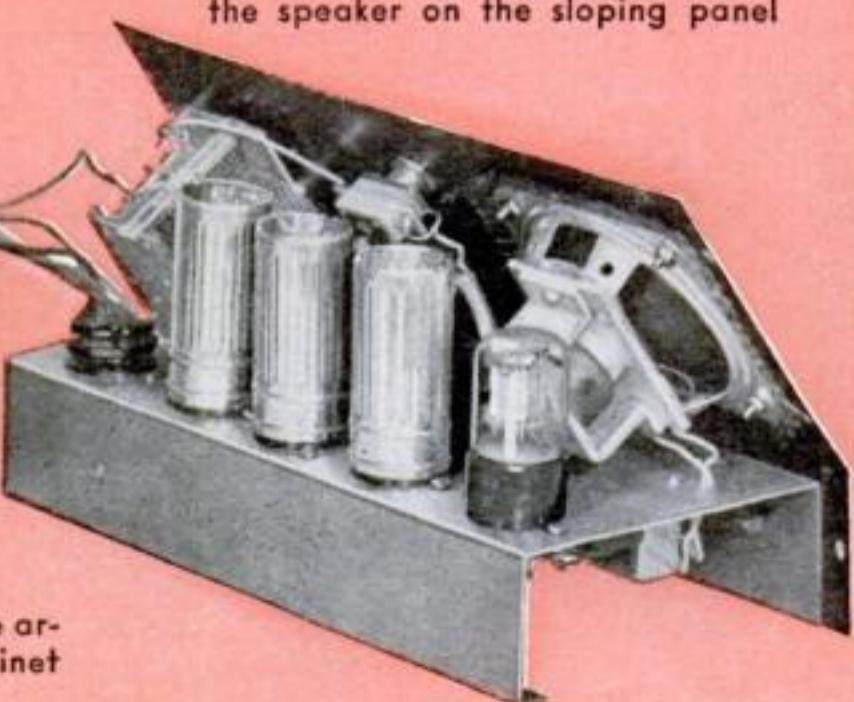
Owing to the directional properties of a loop antenna, a 4' metal rod was chosen instead. The metal rod is connected directly to the grid cap of the radio-frequency tube. Both of the set's coils are tuned by a midget two-gang tuning condenser, which is mounted on the sloping panel by means of two right-angle brackets.

The antenna rod is insulated from the metal cabinet by a ceramic stand-off insulator. The tops of these insulators are usually threaded, and the best method of attaching the aluminum rod is to thread it to fit, and screw it into the insulator. For greater signal strength, the set will have to be grounded. The bicycle

Keep tuned as you ride with this receiver. Note below how tubes are mounted on aluminum chassis, and the speaker on the sloping panel



How batteries are arranged in the cabinet



Radio IS EASY AND CHEAP TO BUILD

frame provides excellent counterpoise capacity for this purpose.

The steel cabinet used for housing the chassis and batteries measures $6\frac{1}{2}$ " by 7" by 11" and is small enough to fit inside a standard-size bicycle luggage basket. The panel is attached to the cabinet by means of self-tapping screws. The two "B" batteries that fit inside the cabinet along the back are the new small-size portable type employing the special flat cells with expanding seals. A 1½-volt "A" battery fits in between the two "B" batteries, with the 4½-volt "C" battery directly in front of it. The "A" and "B" batteries are of the plug-in type and use clip-in plugs with Farnsworth terminals. This system makes it an easy matter to change batteries whenever necessary.

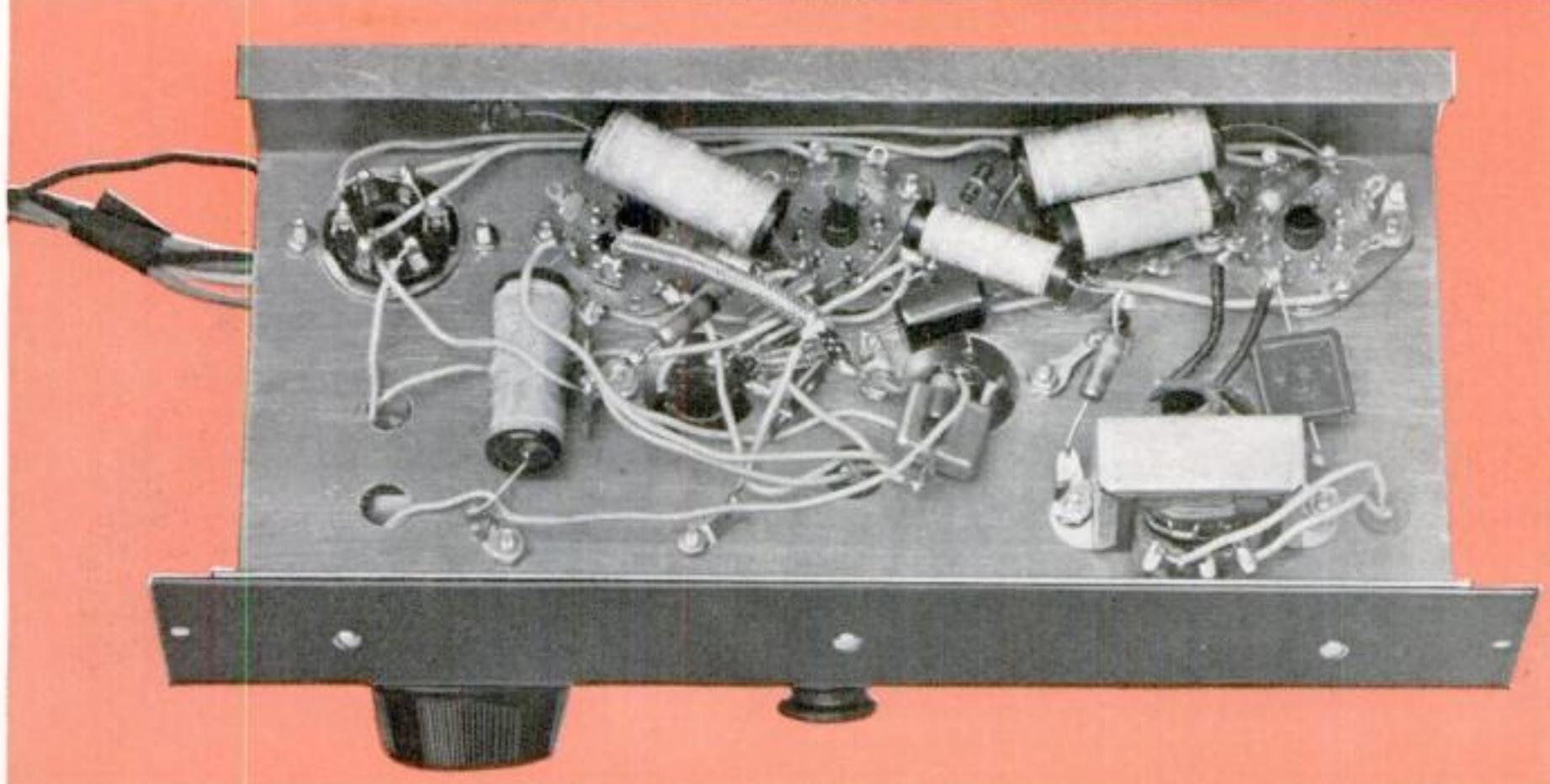
In order to obtain ample volume from the speaker, two stages of audio-frequency amplification

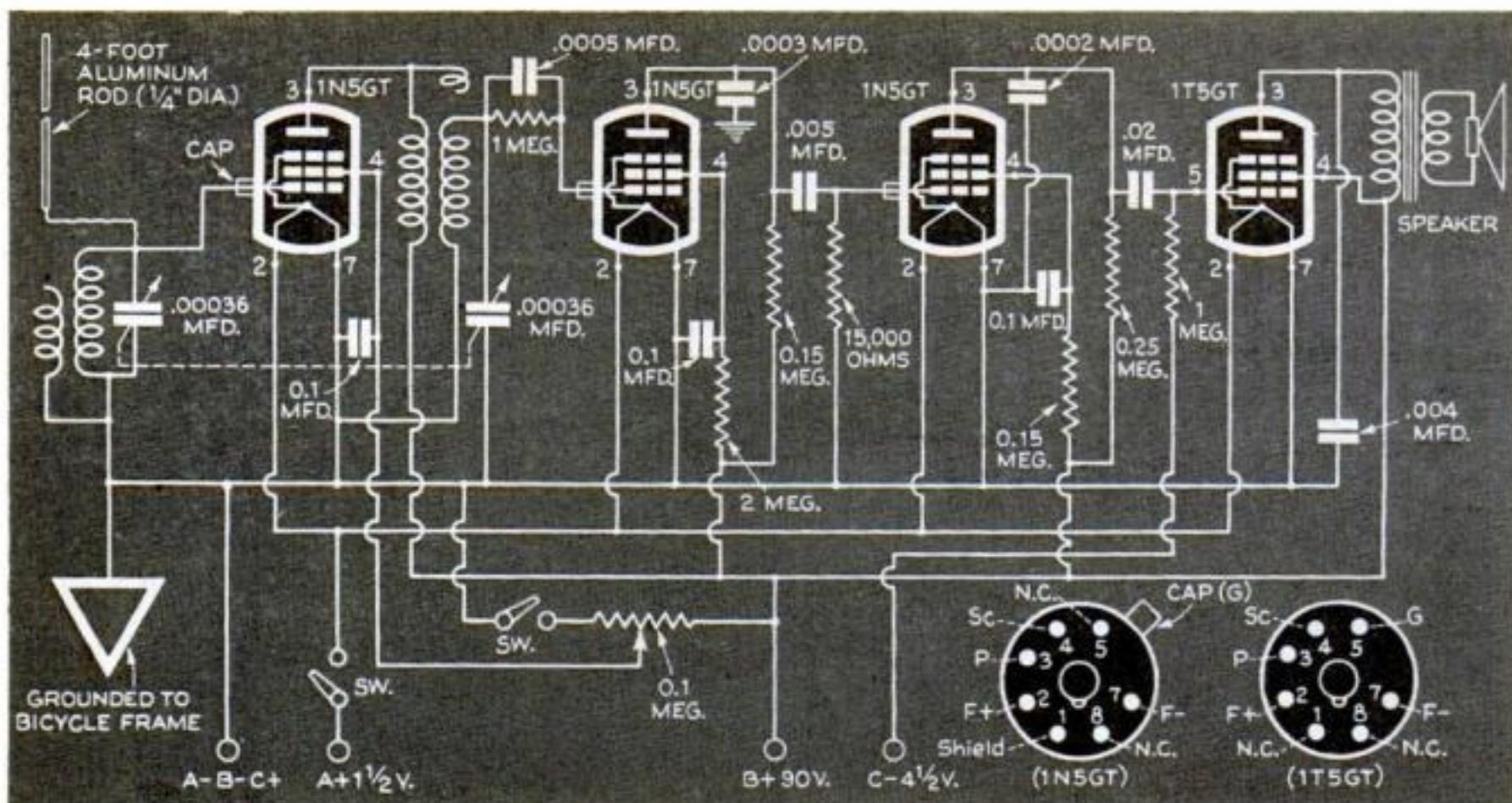
are used after the detector. Both stages are resistance-coupled and use the latest-type tubes for maximum sensitivity. Type 1N5GT tubes are used in the radio-frequency, detector, and first audio-frequency stages. A beam power tube, 1T5GT, is used in the output stage, and provides a relatively high output with a very low filament drain.

A 15,000-ohm, ½-watt resistor is used in the grid circuit of the first audio tube. Any increase in value of this resistor will only cause instability and will fail to in-



It's as easy to tune as a car radio. View below shows the parts underneath the chassis



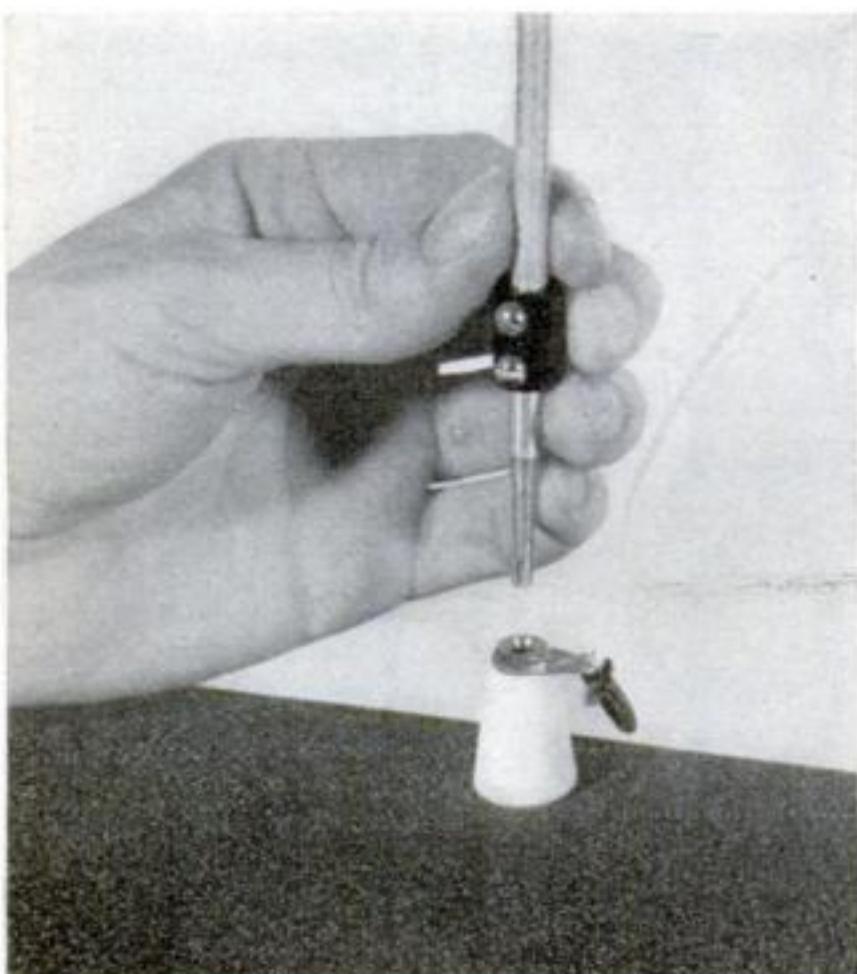


These circuit and tube-socket diagrams should be followed to the letter in constructing the set

crease the amplification. Volume is controlled by a 100,000-ohm potentiometer placed in the screen circuit of the radio-frequency tube.

The key-lock switch is of the double-pole, single-throw type and breaks two circuits at one time, the positive "A" supply and the ground lead of the volume control. This is done to avoid any drain through the "B" supply while the set is turned off.

As a safety measure, it is a good idea to lock the set in the basket or to the bicycle frame. The key switch prevents anyone else from turning on the set.



The antenna rod is set in a ceramic insulator atop the cabinet. Right, a key turns on the set

LIST OF PARTS

Midget 2-gang tuning condenser, .00036 mfd.
Shielded antenna coil.
Shielded radio-frequency coil.
Volume control, 100,000 ohm.
Output transformer.
Carbon resistor, $\frac{1}{2}$ watt, 15,000 ohm.
Two carbon resistors, $\frac{1}{2}$ watt, 150,000 ohm.
Carbon resistor, $\frac{1}{2}$ watt, 250,000 ohm.
Two carbon resistors, $\frac{1}{2}$ watt, 1 meg.
Carbon resistor, $\frac{1}{2}$ watt, 2 meg.
Mica condenser, .0002 mfd.
Mica condenser, .0003 mfd.
Mica condenser, .0005 mfd.
Mica condenser, .004 mfd.
Tubular condenser, .005 mfd., 600 volt.
Tubular condenser, .02 mfd., 600 volt.
Three tubular condensers, .1 mfd., 600 volt.

Miscellaneous: Tubes, four octal wafer sockets, three bantam-tube shields, six-prong speaker plug and wafer socket, key switch, six-way battery cable, batteries, 3" P.M. speaker, cabinet, chassis, antenna, 3" dial, etc.



EUROPE ON ONE TUBE



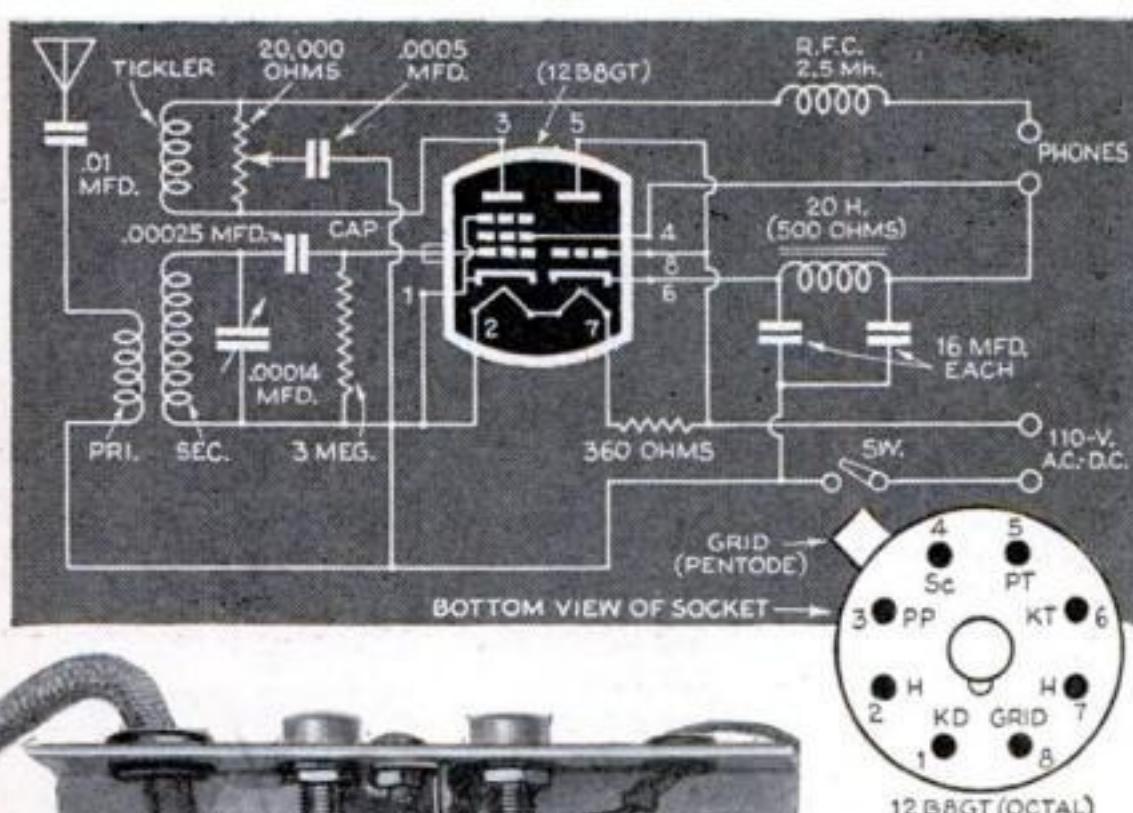
This radio has only two controls. The cabinet scales $4\frac{1}{4}$ by 5 by $5\frac{1}{4}$ in.

BEGINNERS who want to try their hand at building a simple, inexpensive radio will find this compact, one-tube A.C.-D.C. set to be just the type of receiver for their needs. It is easy to build, and with a good outdoor antenna it will pull in stations from South America and Europe almost any evening. Tracing the circuit from the antenna, the signals enter the set through a .01-mfd. paper condenser to the primary winding of a 6-prong plug-in tuning coil. The secondary winding of this coil is tuned by means of a midget, .00014-mfd. variable condenser. A set of plug-in coils gives complete coverage for all wave bands.

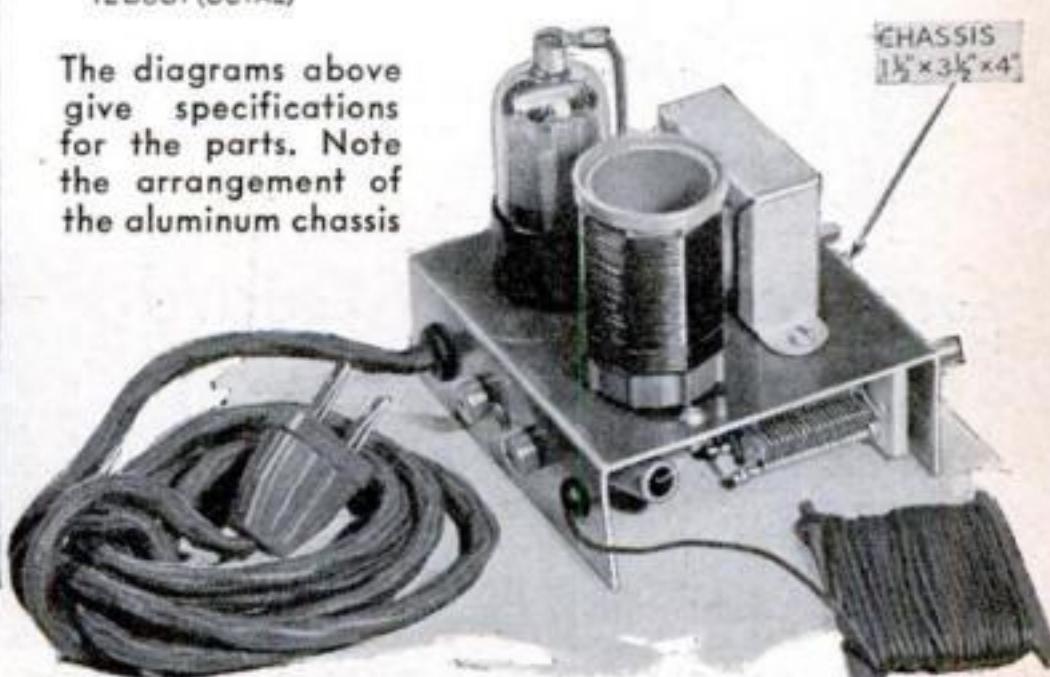
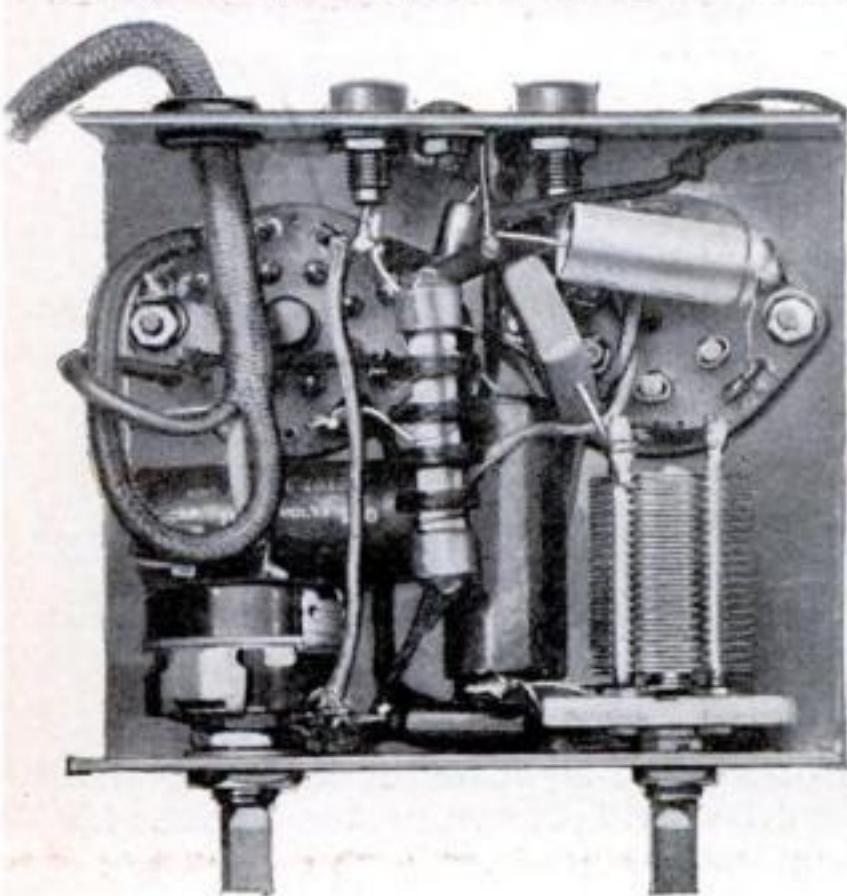
The signals then enter the grid of the detector portion of the dual tube (12B8GT) by means of a .00025-mfd. mica condenser and a 3-meg., $\frac{1}{2}$ -watt resistor.

Signals from the plate of the detector then go to the headphones through the tickler winding and a 2.5-mh. plate choke. A 20,000-ohm potentiometer across the tickler winding controls the amount of feed-back between the tickler and secondary windings.

The second portion of the tube consists of a triode, which rectifies the alternating house current so that only direct current reaches the plate of the detector. Hum is filtered by a 20-h. choke and two 16-mfd., 150-volt electrolytic condensers.



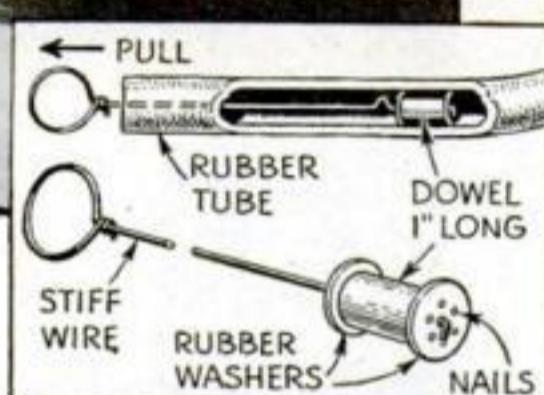
The diagrams above give specifications for the parts. Note the arrangement of the aluminum chassis



Hints for Car Owners



A jerk on the plunger starts siphoning action. Drawing at right shows its simple construction

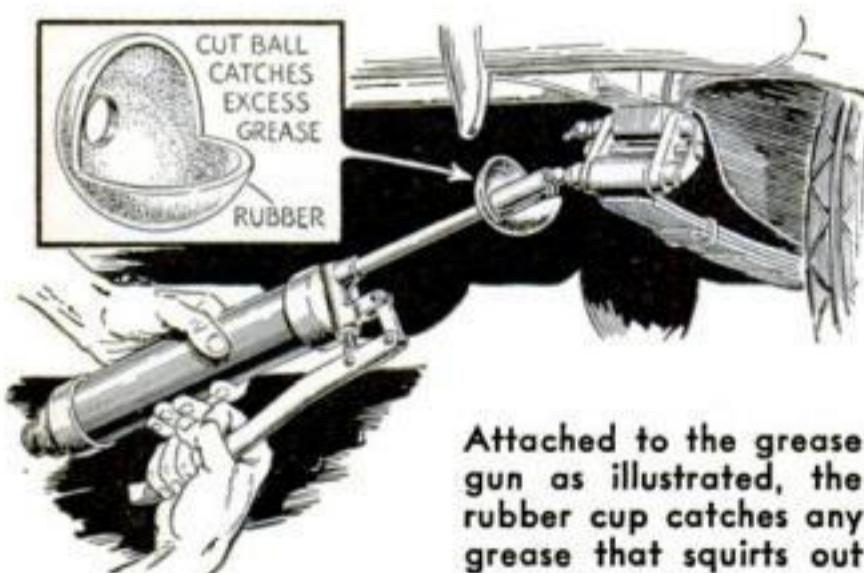
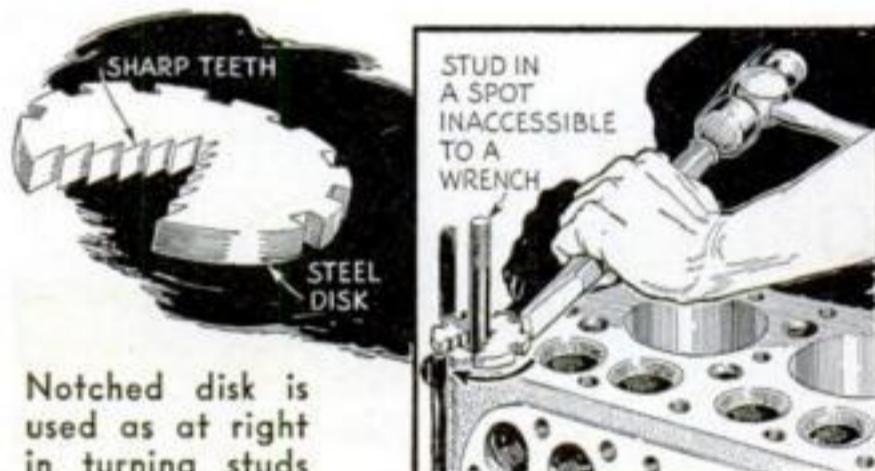


Simple Plunger Aids in Siphoning Fuel

TO START siphoning action when drawing gasoline from an automobile tank, the simple plunger shown at the left is a handy item to have. The unit is easy to make with old clothes-hanger wire and a wood dowel, 1" long and slightly smaller in diameter than the rubber siphoning tube. The dowel is fitted at each end with a rubber washer slightly larger than the tube. When the siphon tube is in place, insert the plunger in the open end. Withdrawing it with a rapid jerk will create enough suction to draw gasoline into the tube and start siphoning action. The mouth of the siphon should be held lower than the end in the tank.—L. H.

Homemade Tool Turns Hard-To-Reach Studs

STUDS on a motor block that are hard to get at with a wrench can be turned easily with a handy tool made from a steel disk. Cut a V-shape notch out of the disk, give its edges sharp notches, and file a few square slots in the disk rim. The tool is seen in use at right.—A. H. W.



Grease-Gun Drip Guard Made from Rubber Ball

WHILE greasing a car, you can catch excess grease and prevent it from dropping onto your garage floor by attaching to your grease gun a rubber ball cut out as shown above, with a cup to hold grease that overflows.—E. H.

Tin Roofing Disks Form Driveway Guide Line

TO MAKE it easy to negotiate a narrow or curved garage driveway, where a wall, the edge of a house, or some other obstruction may be grazed if a car is not held to the center of the roadway, I have found that ordinary roofing tins will form a good driving guide. Held to the paving by means of roofing nails, the tins are laid down on the left of the drive in a line that follows that of the driveway. By making his car hug this line, a driver will always be sure to clear all obstructions.—R. G. F.





OUTDOORS
IN THE SUN

...and they're both
snapshots
to brag about



INDOORS
AFTER DARK

NIGHT SNAPSHOTS SIMPLE AS A-B-C with **KODAK SUPER-XX FILM**

LOADING with Kodak Super-XX Film, many thousands of average picture takers are snapshooting indoors these winter nights. They don't wonder if their pictures will come out—they know they will. For Super-XX is four times as fast as ordinary film—gives you just as good snapshots indoors under Photoflood lamps as you are accustomed to get outdoors in daylight.

And you don't have to buy an expensive new camera, either. For snapshots at night, you use any camera at all that takes Kodak Super-XX Film; even a \$1 Baby Brownie.



A ... Load your
present camera with
Kodak Super-XX Film



B ... Use a couple of
inexpensive Mazda
Photoflood lamps in
Kodak Handy Reflectors



C ... Follow the few simple
directions in the **FREE BOOKLET**

It's like having an expert at your elbow when you snapshot at night with this remarkable booklet as your guide. Written for beginners. Photos and diagrams that will help make everything easy. At your dealer's . . . Eastman Kodak Company, Rochester, N. Y.

DOES BOTH JOBS AT ONCE!



DU PONT **SPEEDY WAX**

(LIQUID)



● Putting a wax polish on your car isn't the long, tough job it used to be. With DuPont Speedy Wax, you can *clean* the finish and give it a lovely wax polish in one operation. You do *both* jobs at once. Speedy Wax is fine for all car finishes.

WANT A SAMPLE?

DU PONT CO., Dept. 1-SP, Wilmington, Del.

Send me a sample of Speedy Wax—enough for hood and fenders. I enclose 6¢ to help cover mailing costs.

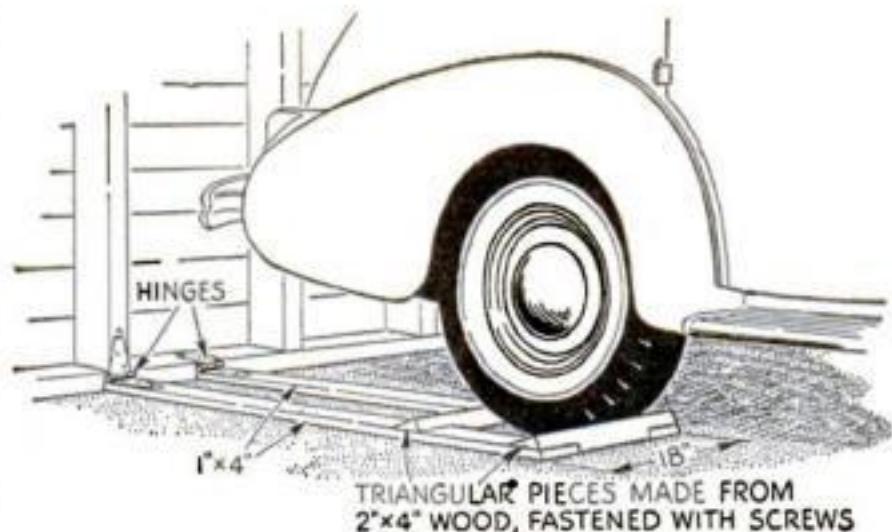
Name _____

Address _____

City & State _____

(Offer good in U. S. only)

RUB "PRO-TEK" ON YOUR HANDS before working on your car. Then when you have finished the job, you can wash the grime off easily. Made by Du Pont.

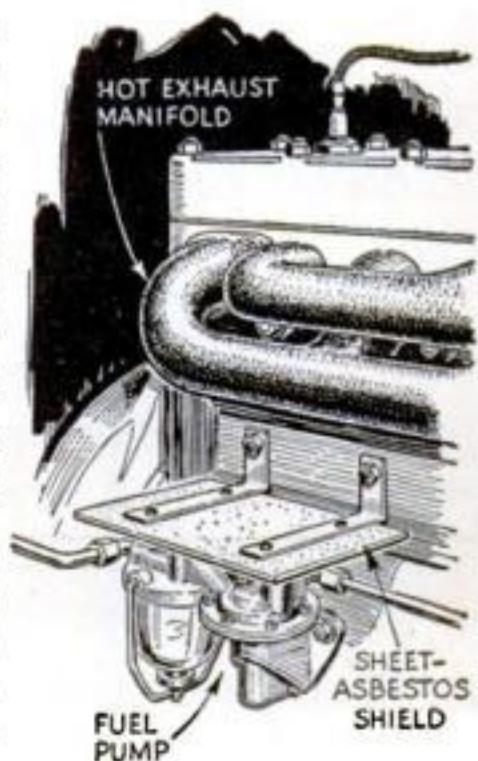


Easily Made Stop Device Positions Car in Garage

MANY owners of new cars find that they are so long that they leave little clearance between the bumpers and the rear walls and the doors of their garages. As a result, it is difficult to position their cars without either hitting the rear wall or leaving the car so that the doors will not shut. To remove this difficulty, I built the limit-stop shown in the accompanying sketch. It is easy to tell by the "feel" when a car wheel rests between the two stops, the position of which was determined by actual measurement. The two stops are cut from one 18" length of 2" by 4" wood, sawed in half lengthwise as shown, and screwed to 1" by 4" boards hinged to the foot of the rear wall. The hinges make it possible to raise the framework when the floor is swept.—A. E. O.

Gas Pump Insulated from Exhaust-Manifold Heat

BECAUSE the gasoline pump and filter bowl in my car were located directly underneath the exhaust manifold, I had trouble with "boiling" or vaporizing of the gasoline in the line. After a while, I figured out a way to solve the problem. I made two angles out of strap iron, as shown in the drawing, and drilled them to the proper size to fit the bolts of the valve-cover plate. Then I bolted them to a sheet of asbestos. The arrangement provided an effective heat shield and stopped the trouble at once.—S. R.





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*Long-distance sleep in oaken casks
gives BRIGGS Tobacco
its extra-mellowness and flavor*

EARLY TO BED, and slow to rise—is a motto that wins riches of mellow flavor for Briggs Tobacco.

When the hand-selected, best-of-the-crop tobaccos are ticketed "O.K. for Briggs",

they are trundled off to bed... for years of quiet slumber in fragrant casks of oak... until time's beneficent balm has gentled each golden leaf to rare smoothness, mellowness and fragrant bouquet.

Briggs is aged *months longer*—than many blends that cost twice its price.

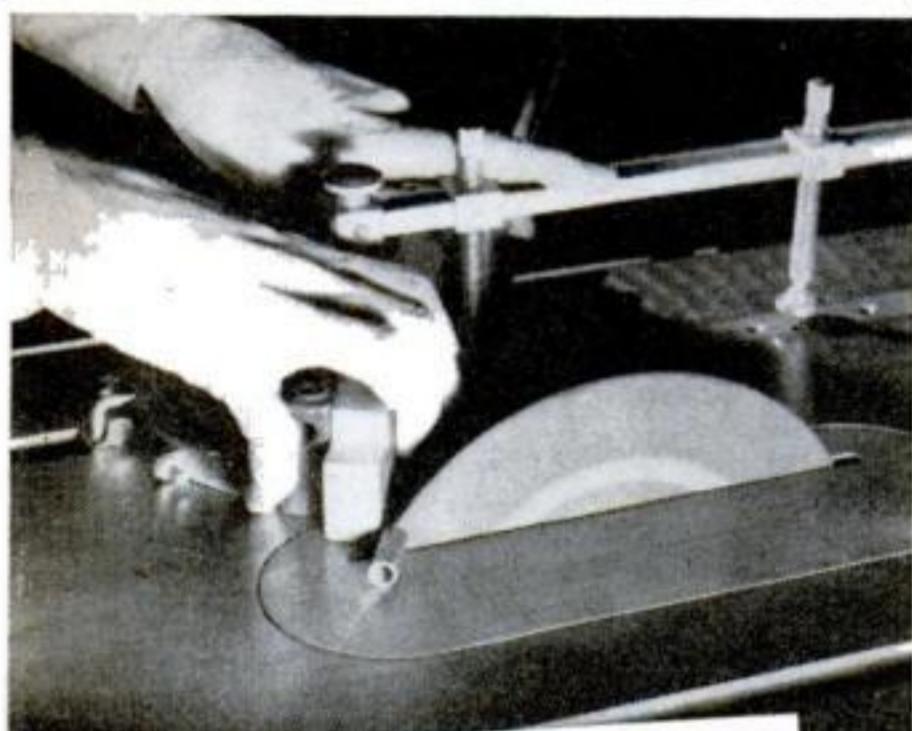
Try Briggs today. Your first pipe-puff will tell you, here is supreme smoking luxury at 15¢ a tin. Your taste will tell you that Briggs is the "friend a feller needs".

CASK-MELLOWED



Extra Long for Extra Flavor

SHORT CUTS FOR THE HOME CRAFTSMAN



How to cut metal tubing in a jiffy!

● Slice metal tubing like butter! It's easy with a Carborundum Brand Silicon Carbide or Aloxite Brand Aluminum Oxide Cutting off Wheel. You'll call it sheer magic when you see how quickly one of these wafer-thin wheels cuts through ordinary metal tubing... or almost any other material, from tempered steel to plastics, small brick and tile. You'll be delighted with the smooth, even kerf it leaves. For most purposes no further finishing is necessary.

The manual offered below tells you more about the remarkable cutting off wheels made by Carborundum, and explains how you can use them to advantage in your workshop.

Ask your hardware dealer or mill supply house to show you the complete line of Carborundum-made coated abrasives, sharpening stones, grinding wheels and other abrasive products for the home craftsman. Send 10c, coin or stamps, for souvenir sharpening stone and valuable illustrated manual on how abrasive products can save time and help you do better work.

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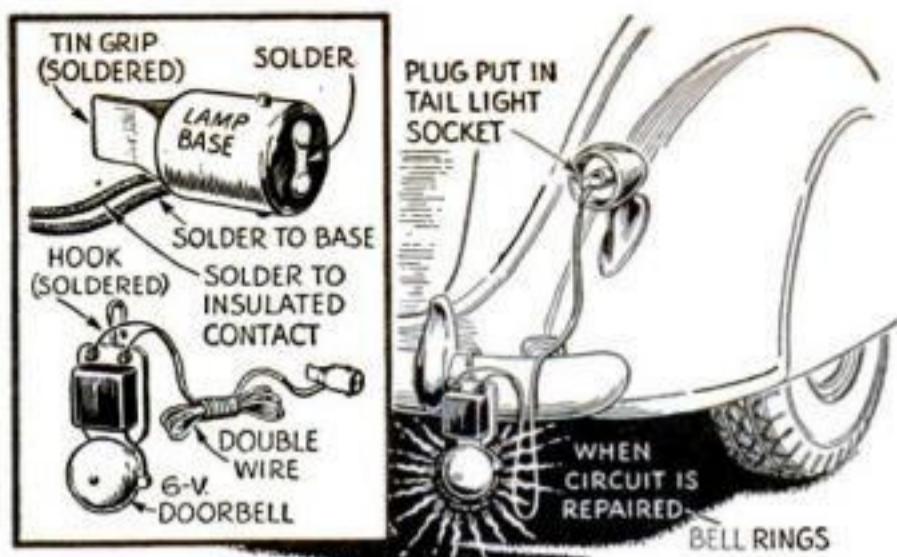
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Niagara Falls, N. Y.

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Tester Rings Bell When Car Circuit Is Repaired

AN EXTREMELY useful as well as simple device for car owners and mechanics, to be used when tracing electrical troubles through a car's wiring circuit, is shown above. I have saved a lot of time and energy using it. For example, when the tail or stop light fails to work, I plug in the bell in place of the light bulb, then proceed to check the system for the trouble. When the bell rings, I know I have found the break. The audible signal saves me the bother of crawling out from under the car a half dozen times to see if the light is working. I also find the bell is as good as a meter for finding dead shorts. A burned-out bulb with a bayonet base, an old door bell, a little wire, a piece of tin, and a little solder, are all you need to make the outfit. The bell should be provided with a hook so that it can be placed conveniently near any car part being tested.—F. S.

Auto Mechanics... Money for Your Ideas

WHETHER you work in a garage or just like to tinker with your car, it's more than likely that you have figured out a novel way of doing various car jobs a little faster or better than usual. Other car owners would be interested in knowing about them, and POPULAR SCIENCE MONTHLY pays well for articles, illustrated with rough sketches or photographs, describing them in detail. Just write a clear description of your pet idea and send it along with illustrative material to the Automobile Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y. If your article is accepted, a check will be mailed to you immediately.



New Sectional Boat Is Easy to Build

HERE is a boat that fulfills requirements for easy transportation. Built in three sections that nest together, the boat is 10' 3" long when assembled. It will carry three or four persons safely and can either be rowed or propelled by small outboard motors up to 6 h.p. Construction is simple and economical—\$18 should purchase all the materials. A feature of this sport craft is the use of canvas-covered plywood, which means not only sturdy lightweight construction but also permanent leakproof qualities. It weighs about 90 lb. Complete drawings and illustrated instructions (No. 382-R) cost only 50 cents.

Plans for many other types of boats are also available. If you wish to build a boat and do not see what you want below, send a self-addressed, stamped envelope for our illustrated boat list. If you are interested in other forms of craftwork, request our regular blueprint list.

BOATS

Cabin Cruiser, 17' long, for use with outboard or inboard drives, 356-357-358-359-R.....	\$1.50
Camper's Utility Boat, 11' 2" long, canvas-covered, for outboard motor or rowing, 281-R50
Canoe, 16' canvas-covered kayak; can be used with sail, 192-193-194-R.....	1.00
Canvas-Covered Duck Boat, 13' 6" long, 279-R....	.50
Family Runabout, 13' 5 1/2" long, weighs 275 lb., for outboards from 1 to 60 h.p.; can also be rowed, 378-379-380	1.00
Fisherman's Outboard Boat, 9' 3" or 11' 6" long, weighs 115 or 160 lb., for motors from 3 to 16 h.p.; can also be rowed, 344-345-R.....	.75
Lapstreak Skiff, 13' 9" long, weighs 225 lb., for 1- to 16-h.p. outboard motors, 363-R.....	.50
Midget Boat or Pram, 9' long, weighs 75 lb., for oars, sail, or outboard motor, 339-R.....	.50
Motorboat-Rowboat, 13' long, decked hull, for use with outboard or inboard drives, 147-R.....	.50
Same, 14 1/2' long, 148-R.....	.50
Same, 16' long, 149-R.....	.50
Racing Sailboat BLACKCAT, 13' 4" long, weighs 250 lb., Marconi rigged, 321-322-323-R.....	1.00
Sailboat, 12' long, weighs 200 lb.; has fast skimming-dish hull, 314-R.....	.50
Sectional Rowboat, 10' 3" long, three sections, weighs 90 lb., built of canvas and plywood; can be used with small outboard motors, 382-R50

(Continued on page 216)

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VISIT famous places and beauty spots! See glorious America — go on thrilling vacation trips. Niagara Falls! Miami! San Antonio! New England! Hollywood! National Parks! No spot too far away when you own a Harley-Davidson! Always plenty doing near home, too — fun with other riders at club rallies, gypsy tours, tourist trophy races, hill-climbs! See your Harley-Davidson dealer NOW!

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BELL PURSUIT

RYAN STM

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or 718 Mission St., San Francisco, Cal.

Plans for the Workshop

(Continued from page 215)

Sectional Rowboat, 9' 8" long, two sections, weighs 60 lb., all-wood construction; can be used with small outboard motor, 340-341R.... .75

RADIO

All-Wave Portable Receiver, 2 tubes, battery operated, 217-R	.50
Amateur Short Wave Receiver, 3 tubes, battery or 110-volt A.C. or D.C. operation, 155	.25
Beginner's Battery Receiver, 365A	.25
Full Electric Headphone Receiver (can be made compact for portable use), 130	.25
One-Tube Receiver, battery operated, 103	.25

FURNITURE

Double-Decker Bed, 277A	.25
Early American Round-Top Stand, 191A	.50
Fireside Bench, Colonial, 187A-188A	.50
Flat Top Desk, 2' 2" by 4' 2" top (no turning,) 20	.25
Floor Lamp, with tripod base, 243A	.25
Four-Leaf Card or Occasional Table, 239A	.25
Hanging Wall Cabinet, 9 1/4" by 24" by 41 3/4", 280A	.25
Magazine Rack, ladder-back style, 250A	.25
Silverware Chest on Stand, 256A	.25
Smoking Stand, modern, 238A	.25
Tea Wagon, with removable tray and drop leaves, 20" by 30" top (turning), 13	.25
Upholstered Stool, 240A	.25

MODELS

BLUENOSE, famous fishing schooner, 17 1/2" hull, 110-111-112-R	1.00
Clipper Ship GREAT REPUBLIC, 31 1/2" hull, 272-273-274-R	1.25
Clipper Ship SEA WITCH, 9 1/2" hull, 219	.25
Coast Guard Patrol of 165-ft. Type, 20 1/2" hull, 286-287-R	.75
Concord Stagecoach DIAMOND TALLY-HO, 20 1/2" long, 115-116-117-R	1.00
Confederate Raider ALABAMA, 21 1/2" hull, 335-336-337-R	1.50
Elizabethan Galleon REVENGE, 21" hull, 206-207-208-209	1.00
Fishing Schooner WE'RE HERE of "Captains Courageous," 9 1/2" over all, 351-R	.50
H. M. S. BOUNTY, 8 1/2" hull, 254	.25
Liner QUEEN MARY, 10 1/4" hull, 283	.25
NOURMAHAL, power yacht, 8 1/2" hull, 276	.25
Ocean Freighter, 14" hull, 271	.25

(Construction kits are available for some of these models. Turn to page 218.)

MISCELLANEOUS

Baby's Crib and Play Pen, 26	.25
Birds and Animals, jigsaw patterns, 56	.25
Colonial Design Doll's House, 72	.25
Doll's House Furniture, 73	.25
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Six Simple Block Puzzles, 65	.25

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Home Workshop Index for 1938	.10
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Send me the blueprint, or blueprints, numbered as follows:

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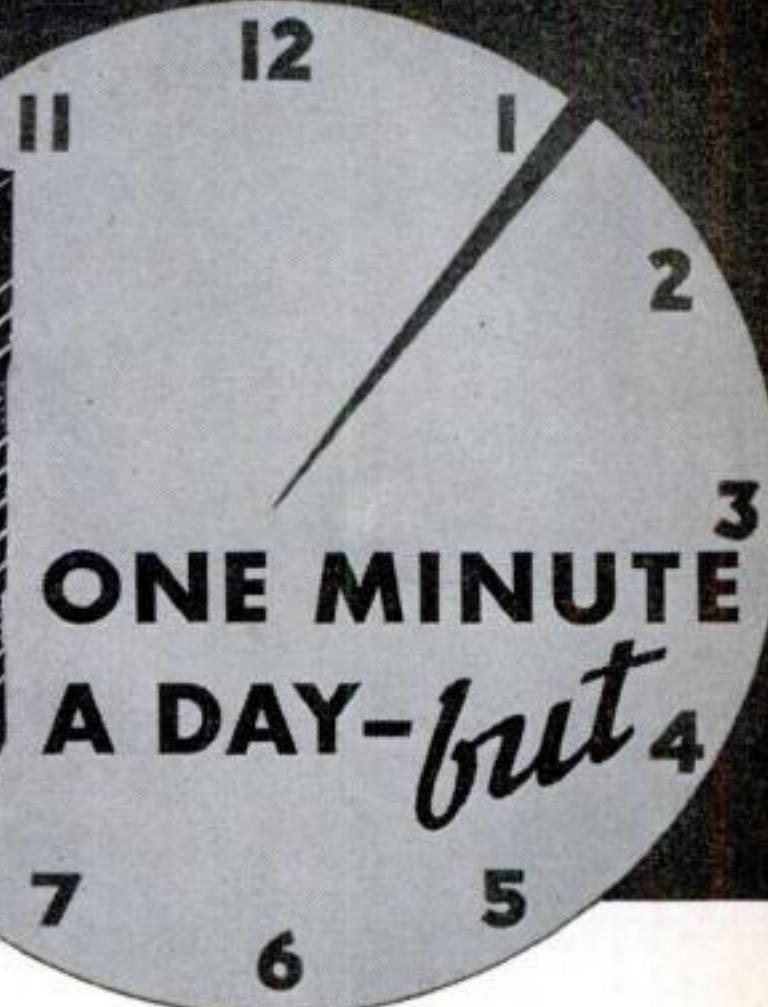
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P. W. RESETS BATHROOM FIXTURES

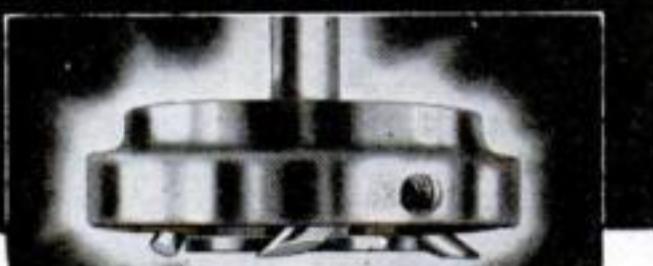
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Costing only \$1.50†, the kit contains all the raw materials for making miniature models of the superdreadnought *Washington*, light cruiser *Philadelphia*, aircraft carrier *Yorktown*, destroyer flotilla leader *Winslow*, four destroyers similar to the *Mahan* and *Gridley*, and submarine *Pompano*. They are built to a scale of 1" equals 100'.

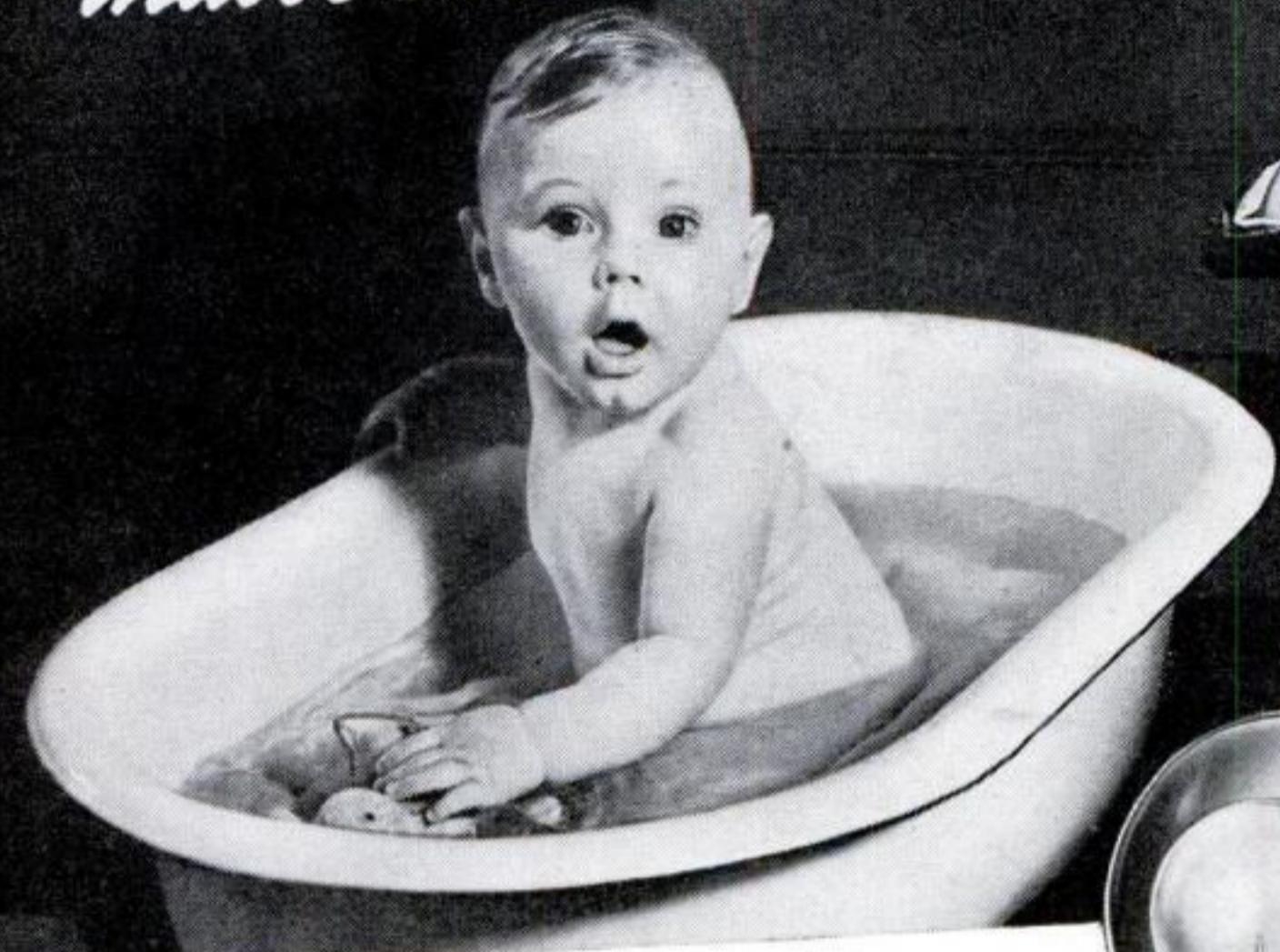
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G.	Elizabethan galleon REVENGE, 25" hull, 28" over all.....	7.25*
L.	Farragut's flagship HARTFORD, steam-and-sail sloop-of-war, 33½" hull, 41" over all	8.45*
Q.	Privateer SWALLOW, a Baltimore clipper, 12½" hull, 20" over all.....	4.95†
V.	Clipper SOVEREIGN OF THE SEAS, 20½" hull, 26" over all.....	4.95†
Y.	Trading schooner, Maine type; 17½" hull, 22½" over all.....	4.90†
2S.	U.S. Navy destroyer PRESTON, 31½" long	5.95*
3S.	CONSTITUTION ("Old Ironsides") 21" hull, 31" over all.....	6.50*
4S.	Clipper ship GREAT REPUBLIC, 31½" hull, 42" over all.....	8.40*
5S.	Coast Guard Patrol of 165-ft. type, 20½" long.....	4.95*

(Continued on page 220)

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Our Construction Kits

(Continued from page 218)



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8S.	Fishing schooner BLUENOSE, 17½" hull, 22" over all.....	4.95†
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R.	U.S. cruiser TUSCALOOSA, 11¾" long.....	1.00
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5M.	Liner PRESIDENT LINCOLN, 14¾" long....	1.50
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H.	Cruiser U.S.S. INDIANAPOLIS, 12" long....	1.50
J.	Clipper SEA WITCH, 9½" hull, 13" over all	1.50

MISCELLANEOUS

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8.	Whittling kit for six different Scotties; each is 2" by 2¼", sawed to shape	1.00
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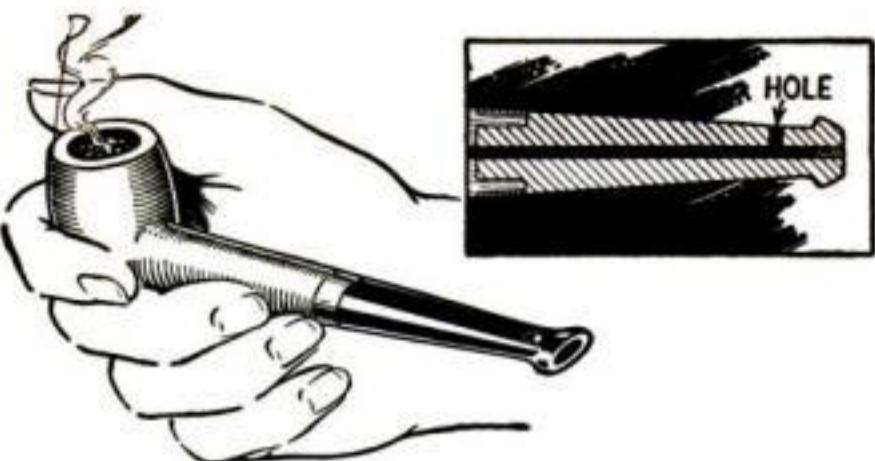
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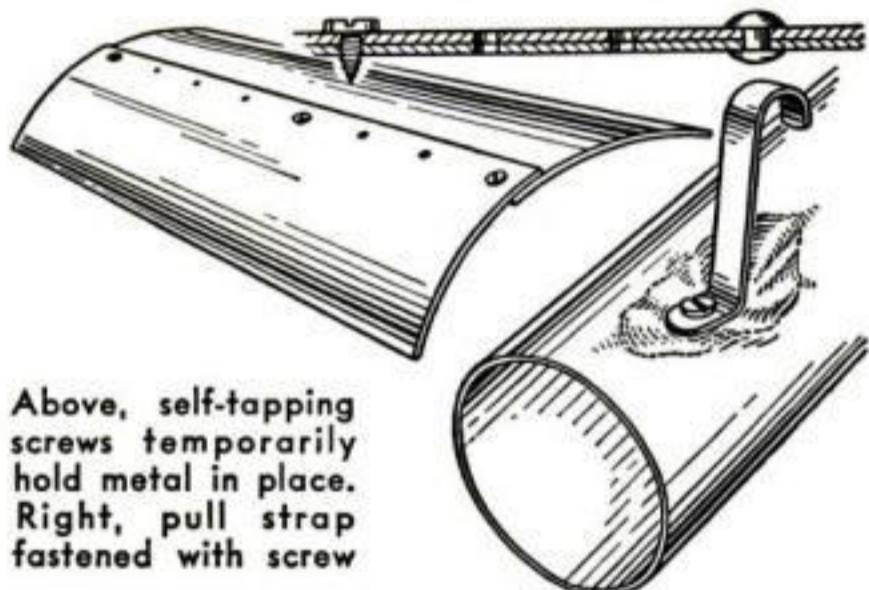
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Hole in Pipe Deflects Smoke from Tongue

CERTAIN pipe smokers have a very sensitive tongue and suffer severely from the "bite" of the tobacco smoke. Others are what are known as "wet smokers," no matter what type of moisture trap they use in their pipes. I have a suggestion for these men that has proved a boon to hundreds of others. First, a hole about $3/32$ " in diameter is drilled through the upper part of the mouthpiece about $1/8$ " from the end. Next, the regular opening of the mouthpiece is closed with sealing wax so that the smoke rises through the hole. To clean such a stem, remove it from the bowl and hold it under a faucet. Pipe cleaners of course, can also be used.—SAMUEL M. SHRAGER.

Holding Sheet-Metal Parts While Being Riveted



Above, self-tapping screws temporarily hold metal in place. Right, pull strap fastened with screw

SELF-TAPPING sheet-metal screws are useful for temporarily assembling sheet-metal parts to check the fits and also for holding them together while being riveted. The screws can be removed as the riveting progresses, and the holes drilled out for the rivets. Another use for the screws is in removing dents in hot-air furnace pipes and other sheet metal. A pull strap is attached as shown in one of the sketches; and after the dent has been removed, the strap is discarded and the screw driven into the hole again to fill it up.—PETER F. ROSSMANN.

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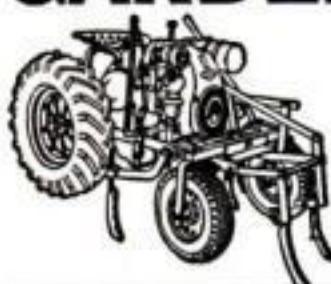
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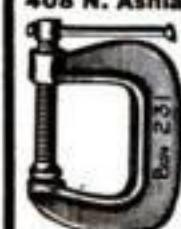
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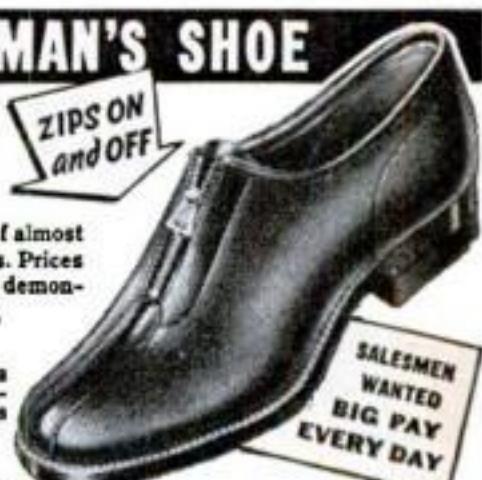
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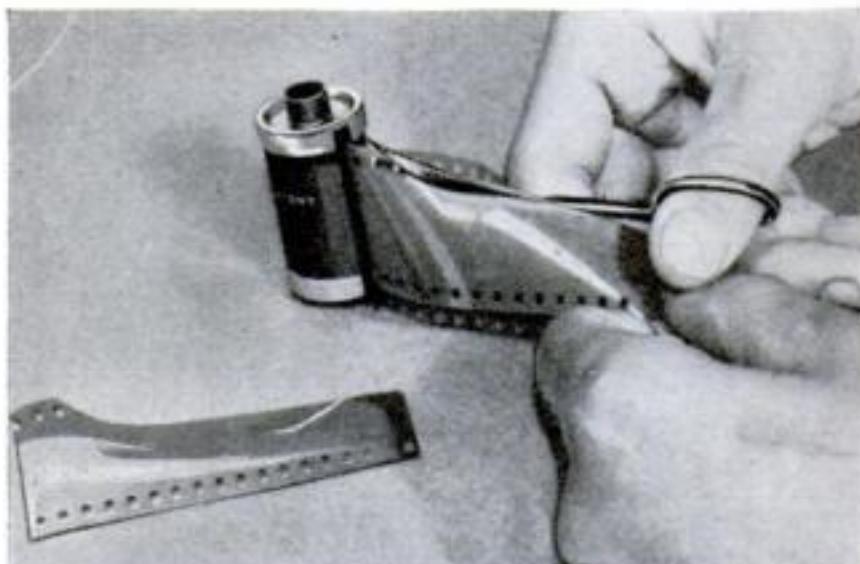
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Cuticle Scissors Trim Film to Smooth Curve

IF THE ends of miniature film have not been properly trimmed, the film may either tear in the camera or give off small chips of film. A special template and knife for cutting the film are somewhat expensive, but curved cuticle scissors form a good substitute and give a smooth curve. Any angle is a point of weakness in a film and should be avoided.—NATHAN SPERBER.



Cutting end of miniature film to prevent tearing

Plug Prevents Shorting Flash-Lamp Batteries

THE dismay of discovering that the battery of your flash-lamp outfit is exhausted because of having been accidentally short-circuited by lens shades, cables or other metal objects with which it is kept, may be prevented by screwing an ordinary electric plug into the socket.

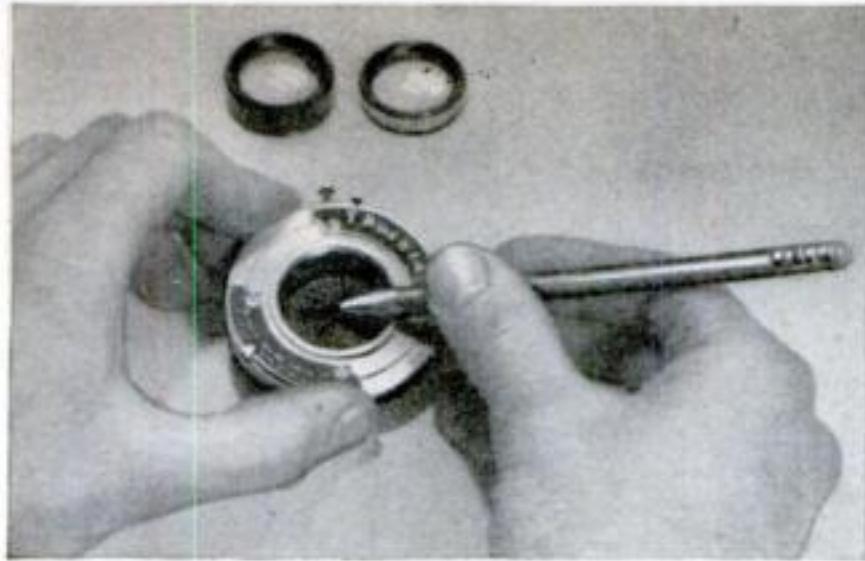
In addition, the plug may be used when you desire to fire a flash bulb remotely, by means of a long extension cord and a reflector some distance away.—K. S.



Boric Acid Lengthens Life of Photo Fixing Baths

For fixing photographic films, the useful life of an ordinary fixing bath may be greatly increased by adding $\frac{1}{2}$ oz. of boric acid to each 2 qt. This is also excellent for paper fixing baths when the weather or the solutions are warmer than usual. Crystal boric acid should be used, as the powdered variety does not dissolve readily.

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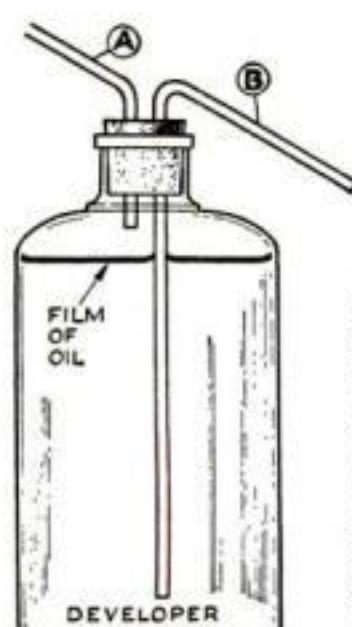


Rust on Camera Shutter Removed with Pencil

RUST spots on the blades of a camera shutter or the aperture of the shutter will cause it to perform badly. Most of the surface of the blades is visible at certain positions when the lenses are removed, and the spots of rust can be removed by rubbing them gently with a common lead pencil. This also lubricates the blades.

Range Timer Used in Darkroom

MODERN electric ranges are often equipped with an internal timer that can be borrowed for darkroom use. A bell rings at the end of interval for which it is set.



Oil Film Keeps Photo Developer from Spoiling

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indispensable part of the darkroom equipment at Acadia University, Wolfville, Nova Scotia. A friend in the chemistry department suggested that a film of this oil would be inert to the chemicals in the developer and at the same time prevent oxidation. The only difficulty was to get the developer out of the container without mixing it with the oil. The long tube *B* of the dispenser extends to the bottom of the bottle, and when air is blown into the tube *A*, the developer is forced out through tube *B*.—G. R. MORRIS and C. L. ILLSLEY.

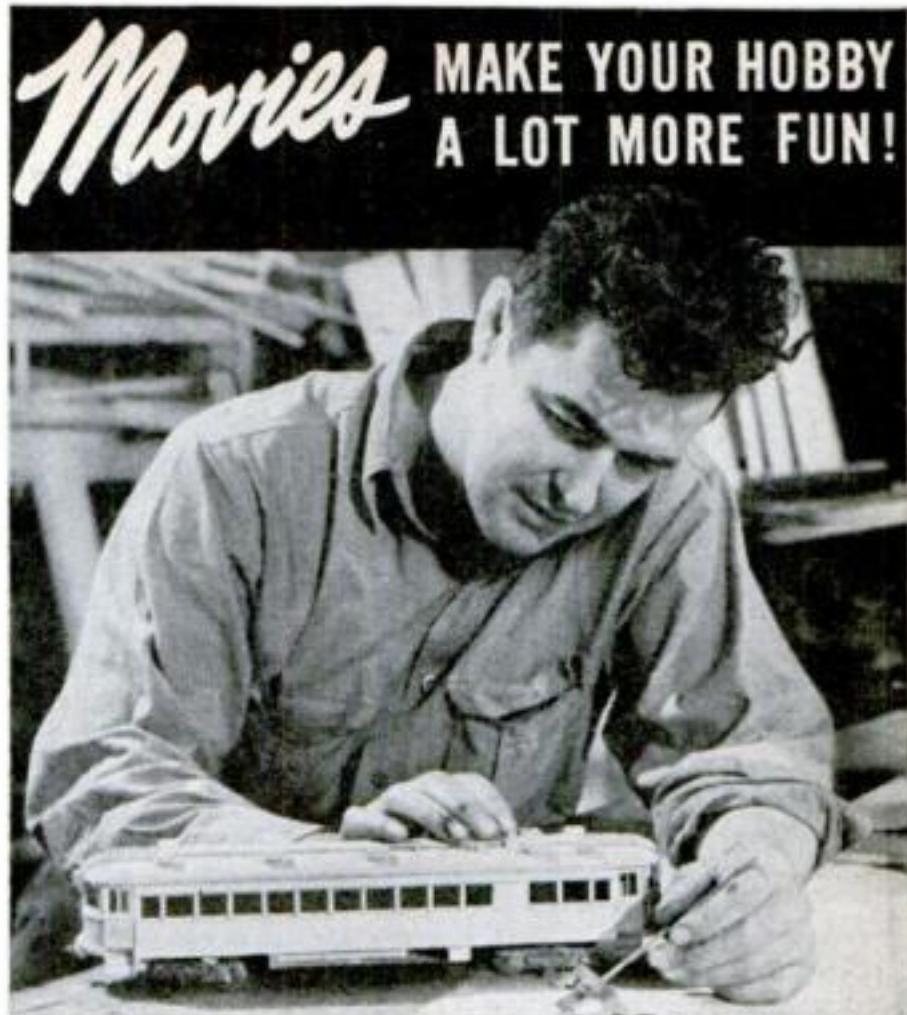
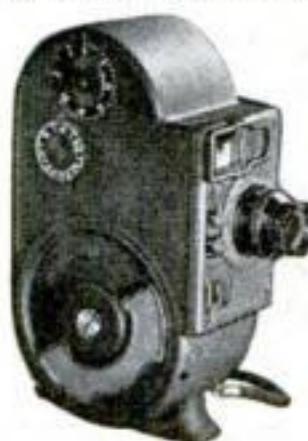


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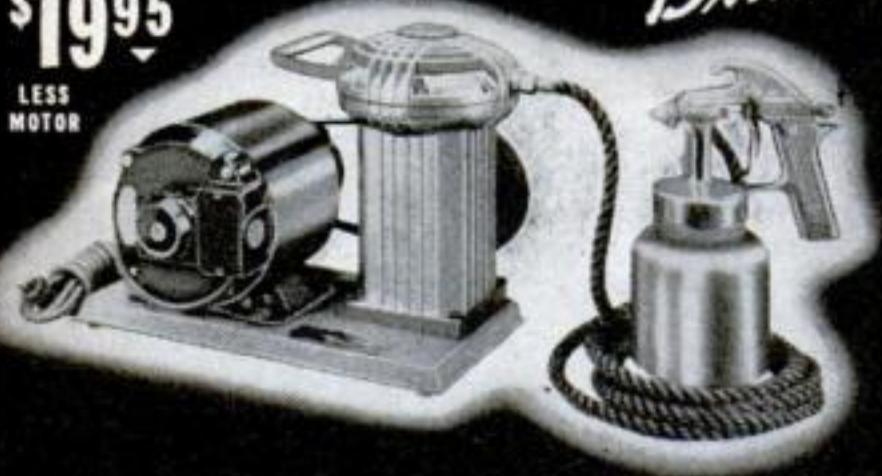
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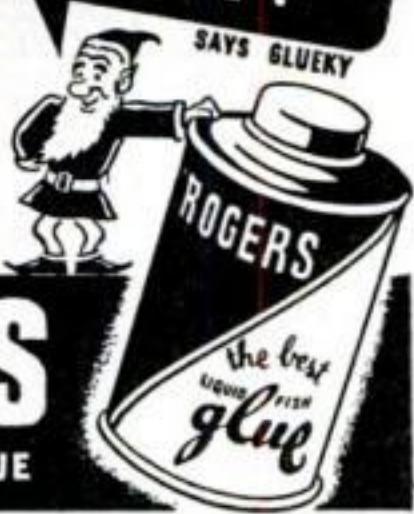
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(Continued from page 54)

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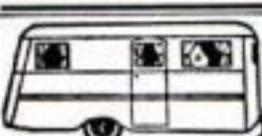
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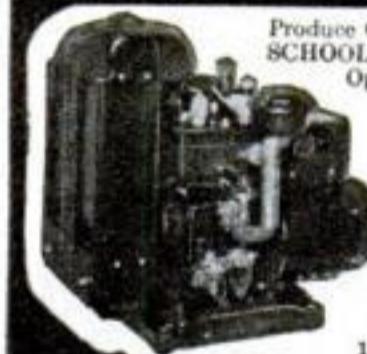
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Uncle Sam's Hell Buggies

(Continued from page 79)

also is of advanced design. It is heavier, more heavily armored, and a more powerful all-around fighting weapon than the light tank, but it isn't nearly so fast on the road, and its use is restricted to districts where the bridges can bear its increased weight. Our army has no very heavy tanks—the so-called land battleships built for special purposes by some European armies.

The tank is the offense's answer to the defensive power of the machine gun. The defense has found several answers to the offensive power of the tank. Most spectacular of them is the quick-firing antitank gun. The model now being produced for our Army is of 37-millimeter caliber and its two-pound shells pierce an inch and a half of modern armor at 1,500 yards. Other armies have similar weapons.

Attacking infantry advances at the speed of about two miles an hour. On average ground, tanks come under direct fire from antitank guns at a range of about 1,000 yards. So if the tanks limit their speed to the speed of the infantry, they are under direct fire of weapons capable of destroying them for seventeen minutes. If they advance at their top cross-country speed of about thirty miles an hour—which wouldn't often be possible in war—the danger period is reduced to a little over a minute. The light tanks now being built carry a 37-millimeter gun of their own for use against machine-gun emplacements and antitank guns, and perhaps against enemy tanks.

At long range, a gun on the ground has an advantage over a tank; at short range, a tank has an advantage over a gun on the ground. The quicker tanks can get to close quarters, the more likely they are to win. No matter how fast they are, some of them will be knocked out by artillery or antitank-gun fire. Tankers are trained to act fast when it is time to "leave her"—to get out on the ground with their machine guns and protect their disabled tank against capture.

The American idea is for the tanks to go in at the best speed possible, and to reach and cruise over their objective while infantry supports them with its fire and the artillery concentrates on the enemy's anti-tank guns. After the tanks have destroyed the enemy machine-gun nests the infantry will be able to filter forward with slight losses. Bullheaded hammering against impregnable defenses has no place in the American conception of tank tactics. A tank attack should be a swift, surprising, and hard-hitting blow where it will hurt.

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Assembling OK-4 At Home In a Few Evenings!

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SAVES UP TO 30%
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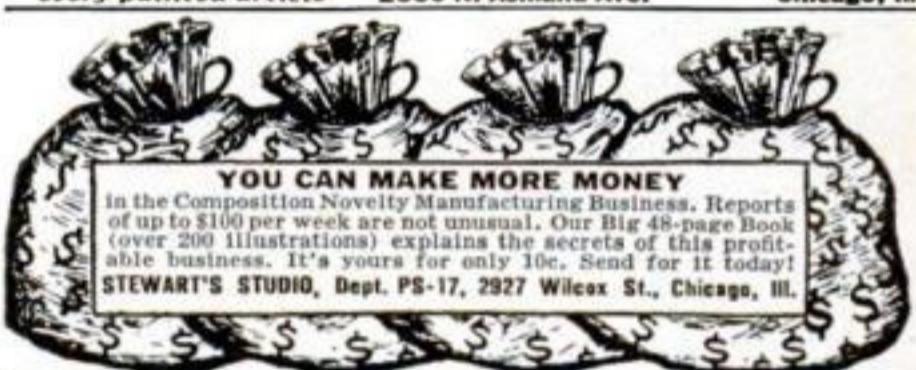
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Quality Tools—products of SpeedWay, for 30 years leading manufacturers of electric tools. Specially wound high torque 110V universal tool motors. Improved designs; correct speeds. 1000 RPM Drill with die cast handle has 1/4" capacity in steel. 20,000 RPM Hand Grinder has speed essential for efficiency and collets for both 1/4" and 5/32" arbors. Drill and Grinder sold singly or together with 5 accessories in fitted Steel Kit. Stand takes either drill or grinder. Router Frame converts grinder into router. Bench Grinder is complete with motor. Adjustable rests, rubber feet and cord. Write for Circulars.

ROUTER 395 STAND 5395 GRINDER 5985

SpeedWay Mfg. Co. 1824 S. 52nd Ave., Cicero, Ill.

Calling the Close Ones

DID you try your skill as a baseball umpire with the photographs of "close ones" on pages 112 and 113? Here are the actual decisions in these cases, with the reasons:

1. The umpire called the runner out. Note that the only foot actually touching the base is that of the first baseman, who has the ball. It may have looked close from the bleachers, but the umpire was on the job and made the correct call.



2. Look at the photograph above, and you'll see how that close play at second base looked from the umpire's position. The runner obviously missed touching the base with his foot, although from the point from which the other view of this play was taken, it looks as though his foot is on the bag. The player at the left, the second baseman, has the ball and is just touching the bag for the force-out. Since this is a force play, the runner doesn't have to be tagged.

3. Safe. The throw arrived too late for the third baseman to pin it on the runner.

4. Safe.

5. Out. There were howls from the fans who viewed the play from the stands near the camera that took the picture, but it was out a mile to those on the other side of the diamond.

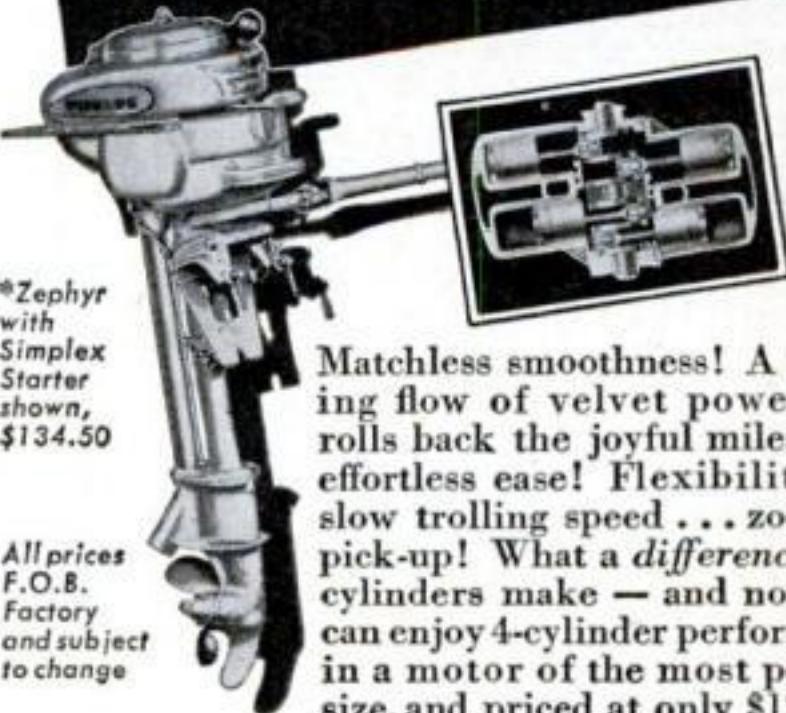
Stars Not So Far Away

MORE than 5,000 of the stars nearest to the earth are only a half or a third as far away as astronomers have believed in the past, according to Prof. Jan Schilt, of Columbia University, New York City. Analyzing determinations of distances of "nearer" stars, Prof. Schilt found a small systematic error which changes the calculation.

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4 cylinders
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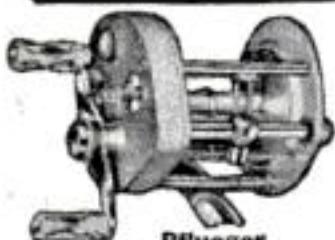
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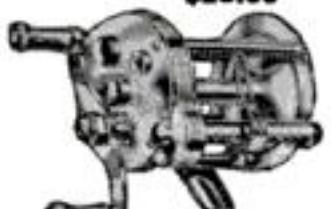
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RUBBER-POWERED
—BUT IT LOOKS
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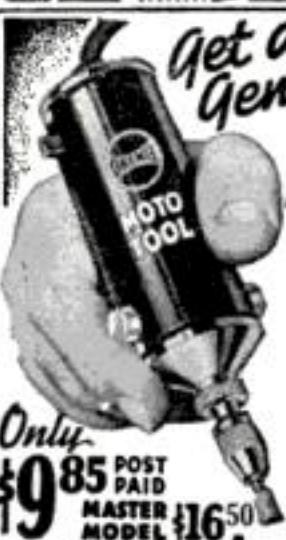
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PROJECT BOOK

Big 24-page book shows how to make 41 plastic projects. Sent postpaid for only \$1.

Foiling the Gold Thieves

(Continued from page 119)

the Gold Reserve Act of 1934, making it a crime to "bootleg" or hoard old gold. You could bring in new gold, fresh from the mine, and get \$35 an ounce for it, and also for old scrap gold—earrings, watch cases, jewelry mountings, dental fillings—provided they were not melted down. Melted scrap might be melted gold coins, legally worth only \$20.67 an ounce. But a jail sentence awaited anybody bootlegging old gold—you simply had to turn it in to Uncle Sam at \$20.67 an ounce.

But merely passing a law doesn't make it work. Right now, probably \$200,000,000 worth of it still is waiting the chance to be smuggled back into circulation. To make the hoarded gold into scrap jewelry wouldn't pay. But there's another possibility—to pass it off in ingot form, as newly mined gold. So, to cover their tracks, bootleggers buy some little hillside mine, hire a few men, start the machinery going; then melt the hoarded gold into bullion, and offer it for sale as product of the mine.

A California law requires every gold buyer to take out a license, and to turn in a ticket to the State Mining Bureau reporting each purchase he makes. The 50,000 tickets that annually come through that office give it a pretty clear picture of the gold traffic in the state. Now and then something arouses suspicion and the inspectors go to work on the case. Days and weeks of careful investigation follow. Operatives hide in the hills, watching a mine that made a rich shipment. The number of men working in the mine and their hours are recorded. Mining engineers study the reports and can readily tell whether or not that amount of gold could have been produced. The size of the tailings pile may be compared with the richness claimed for the ore and the amount of gold offered for sale. When the next shipment comes into the Mint, supposedly from the mine, the experts will have all the evidence they need.

Sometimes an agent will pose as a fence, buying stolen gold from the petty thieves in order to trap the "big shots" who reap the big harvest from this traffic in "hot" gold.

To bolster their ingenious sleuthing methods, the law-enforcement officials are now putting to work such branches of science as microscopy, geology, mineralogy, and chemistry to aid in their relentless war against criminals who flout the law with stolen gold. And their ever-increasing success gives strong evidence that the mysterious and costly gold leaks in many valuable mines soon will come to an end.

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A whole tool shop in your hand—finest, fastest, most powerful tool for its weight, 12 oz. Full of thrills for everyone. Uses 300 accessories to grind, drill, polish, cut, carve, rout, saw, sand, sharpen, engrave, etc. 25,000 r.p.m. Plugs in any socket.

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ship, train, plane or house
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MASTER GLAZE CO., 7720-175 W. Harwood Ave., Milwaukee, Wis.

Gus's Ignition Analyzer

(Continued from page 134)

The remedy is the same—a new coil. But before you buy one, check on your condenser—a condenser that's in bad shape will cause an intermittent miss. Also, a short, weak spark usually is caused by a poor condenser, or one of the wrong capacity. Until you've had a good deal of trouble-shooting experience, it's a good idea to suspect the condenser first and the coil second.

"Poor condensers cause a lot of distributor-point grief, too. They're often the underlying cause of an engine being hard on points, and they're the most common cause of burned points.

"Even if your coil and condenser are in good shape, you can't get the most out of your ignition system unless the distributor points are perfectly spaced. If the points are set too close they'll burn. If they're set too far apart, they'll cause hard starting. Using the ignition analyzer, you can determine the best point-spacing for your car by carefully adjusting the points while the tester motor is running until you get the fattest, longest spark possible on the tester with steady firing. When you replace the distributor head plate, set the points to exactly that gap, and you'll get the highest possible ignition efficiency. . . . Well, what do you think of my ignition analyzer?"

"I think," Dr. Marvin said, "that it's a darned interesting and darned useful gadget, and I'm going to make one the first evening that I can get to myself."

CONTEST WINNERS

IN THE December 1939 issue, Martin Bunn offered \$100 in prizes for letters describing queer car troubles and their cure. The following are the winners:

FIRST PRIZE (\$50): Donald R. Foote, Marshfield, Mass.

SECOND PRIZE (\$25): Paul H. Crane, Lake Mohawk, N. J.

THIRD PRIZE (\$5): Morris Waldman, Chicago, Ill.

FOURTH PRIZE (\$5): Thomas Garland, Wichita, Kans.

FIFTH PRIZE (\$5): George Blazek, Omaha, Neb.

SIXTH PRIZE (\$5): Alfonso Rey, San Juan, Puerto Rico.

SEVENTH PRIZE (\$5): Alfred M. Flatico, Cleveland, Ohio.

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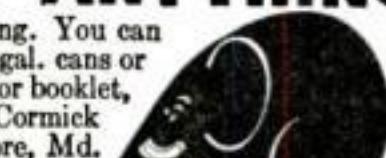
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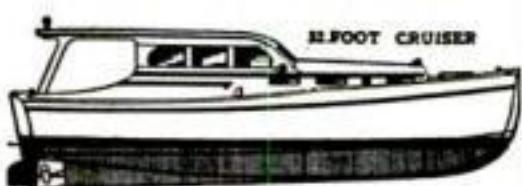


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Hair Tells a Story Under Your Microscope

(Continued from page 200)

beaten and worked together, the fibers become interlaced, and the serrations, each acting like a tiny tooth or hook, hold them firmly together. In this way felt, the familiar hat material, is made. This interlocking action also accounts for the shrinking, compacting, and thickening of woolen garments such as socks after they have been worn and laundered a few times.

Wool such as that used in cloth is composed of the hairs that grow abundantly and form an insulating layer close to the animal's skin. Longer, coarser hairs that extend beyond the woolly layer are more for protection than for warmth. These coarse hairs are removed in the manufacture of fur neckpieces and other products in which only the "fuzzy" hairs are desired.

If you have a micrometer attachment for your microscope, you will find it interesting to measure the diameters of hairs. You will discover then that the expression "by a hair's breadth" is not a very definite one, for the hair of a bat is only about 0.006 mm. in diameter while that of a dugong from the Indian Ocean may be nearly 190 times as large!

You cannot tell much about the cellular structure of a hair simply by looking at it on a slide. Splitting it with sharp razor, used like a knife in whittling a thin shaving, will reveal something of the arrangement of the cuticle and other regions. Soaking a hair for a day or more in weak hydrochloric acid will enable you to break it down so that its structure can be observed better. To separate the long, threadlike cells making up the cortex requires soaking in hot sulphuric acid. It has been determined that a human hair has about 50,000 of these slim, pointed cells in its cross section.

CAUTION: If you are not experienced in handling acids, better not try the hot sulphuric treatment. Sulphuric acid, when cold, is a powerful and dangerous chemical; and when hot is even more so. Hydrochloric acid, even when diluted, should also be handled with extreme care, and kept off skin and clothing.

In addition to studying hairs as a whole and when broken down, you will want to examine some cross sections. These can be cut with the aid of the fiber-sectioning plate described in a recent installment of this series. Another way of obtaining sections (usually oblique) of human hair is to wash the soap from the scrapings of a razor after shaving.

This One



9ZP6-JJD-TK9H

Tricks with Fire

(Continued from page 203)

the glow, called chemiluminescence, will be observed.

A convenient substitute for a dark room, in observing this phenomenon, is a viewing chamber such as may be made by fitting an eyepiece to an aperture in the side of a box, and making a small hole in the box lid for adding hydrogen peroxide with a medicine dropper. If you have made the viewing box for fluorescent specimens described a few months ago (P.S.M., July, '39, p. 188), it can be put to good use for this purpose. Support it on its side, and replace the sheet of purple glass with a sheet of cardboard, through which the hole for the medicine dropper is punched. Viewing the contents of the beaker from the side, instead of looking straight down into the vessel, avoids risk of having any of the chemicals spatter into the eyes.

Another example of luminescence, described some years ago and worth recalling for comparison, is the mysterious violet glow of strong sulphuric acid in a Bunsen flame. This glow may be observed in a partly darkened room by filling a test tube with cold water, moistening the outside of the tube with a few drops of the acid, and then passing the tube back and forth in a faintly blue Bunsen flame. According to a proposed explanation, atomic hydrogen in the flame reduces the sulphuric acid to elementary sulphur, which then oxidizes with luminescent effect.

POPULAR SCIENCE Question Bee

THESE are the correct answers to the Question Bee on page 130. Give yourself five points for each one you had right. A total score of 75 to 85 is good; 90 or better is excellent.

1. c	5. b	9. c	13. c	17. b
2. a	6. b	10. c	14. a	18. b
3. d	7. b	11. c	15. b	19. b
4. d	8. b	12. d	16. d	20. c

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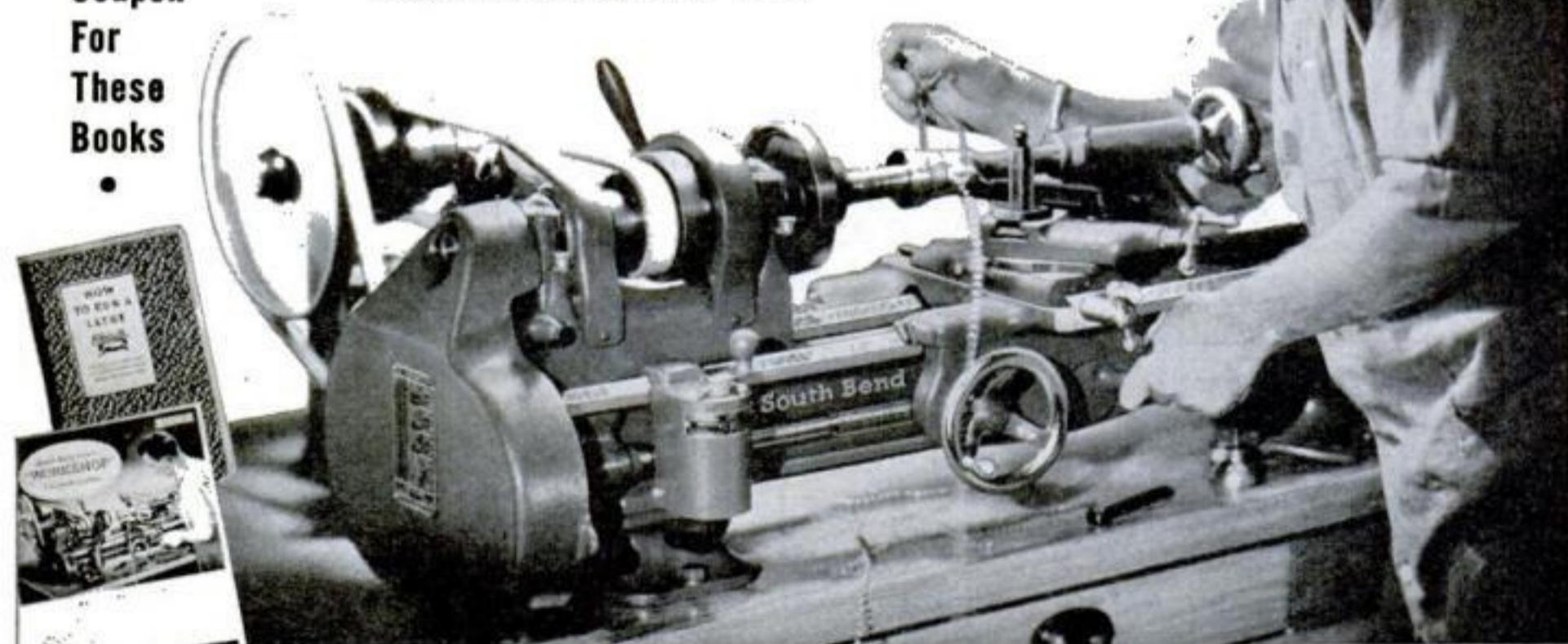
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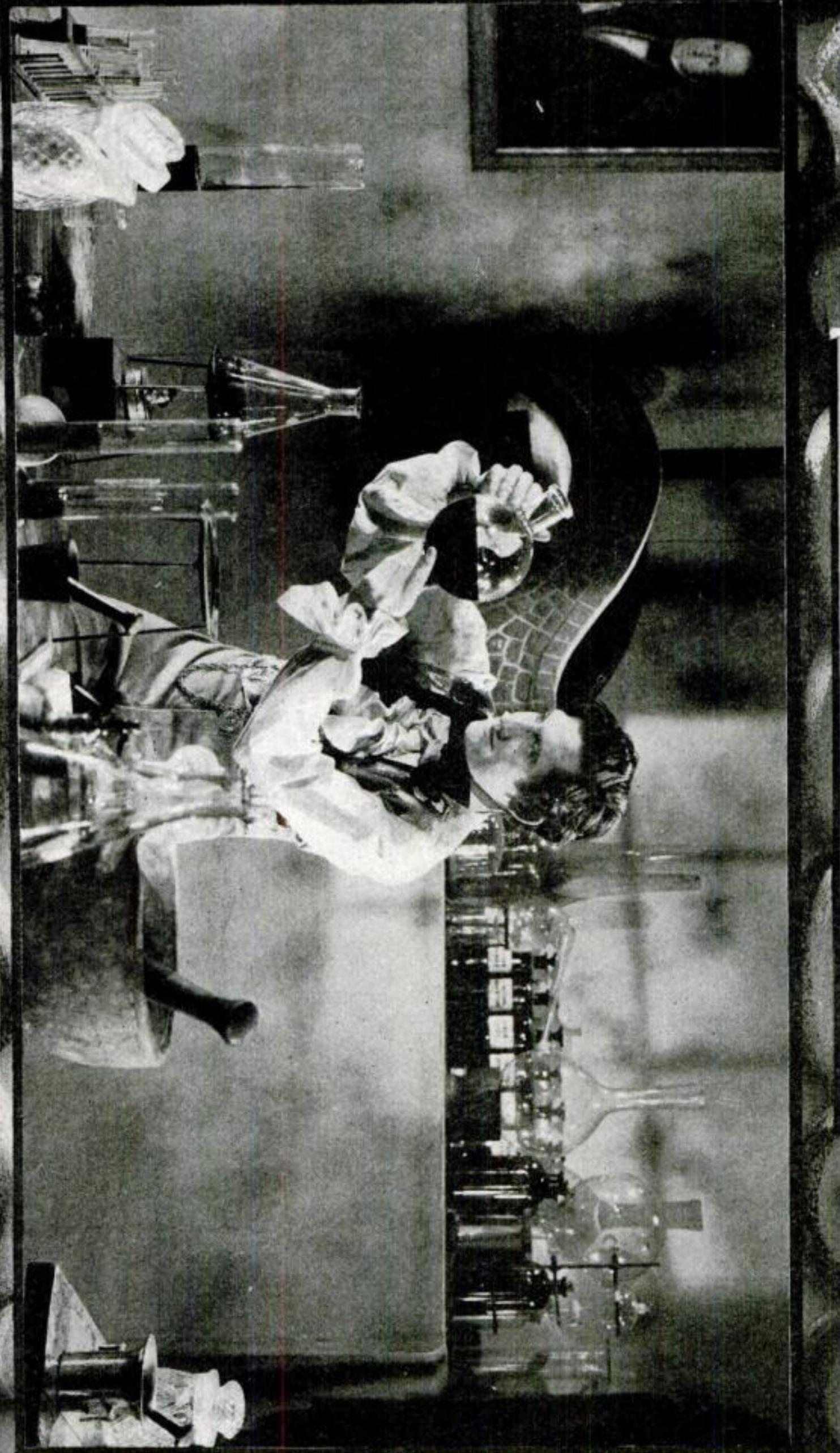
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